UNITED STATES DISTRICT COURT

FOR THE WESTERN DISTRICT OF WISCONSIN

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WISCONSIN ALUMNI RESEARCH FOUNDATION,

Plaintiff,

-vs- Case No. 14-CV-62-WMC

APPLE, INC., Madison, Wisconsin
October 15, 2015

Defendant. 8:33 a.m.

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STENOGRAPHIC TRANSCRIPT OF NINTH DAY OF JURY TRIAL
MORNING SESSION
HELD BEFORE CHIEF JUDGE WILLIAM M. CONLEY, and a jury

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E-X-H-I-B-I-T-S

E-X-H-I-B-I-T-S

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(Proceedings called to order.)

THE CLERK: Case Number 14-CV-62. *WARF v. Apple* called for the ninth day of jury trial. May we have the appearances, please.

MR. CHU: Good morning, Your Honor. On behalf of WARF: Morgan Chu, Gary Frischling, and Jason Sheasby.

MR. LEE: Morning, Your Honor. Bill Lee, David Marcus, Jim Dowd, and Cathy Cetrangolo for Apple.

THE COURT: Very good. Unless there's something more for the parties then, I'll start with the plaintiff WARF.

MR. FRISCHLING: There is one issue, Your Honor, regarding two exhibits that appeared in

Mr. Williams' direct binder that we saw last night. 1352 and 1226 are two other patents of Mr. Williams. As far as I can tell, and I coordinated with counsel this morning, they're unrelated to the LSD predictor. They're on other features of the chip. And so we have a relevance concern on that testimony obviously.

THE COURT: Anything else for your client this morning?

MR. FRISCHLING: That's it, Your Honor.

THE COURT: All right. Let me hear from Apple as to your reason for introducing it.

MR. LEE: Both patents relate to the SoC, Your Honor, and the question is how do you allocate the value of the SoC --

THE COURT: I'll allow the introduction of the two patents. We're not going to go into the details.

MR. LEE: We're not.

THE COURT: That's fine. And is our witness --

MR. LEE: Mr. Williams is here.

THE COURT: Mr. Williams, if you would come forward and be seated. Was there anything more for --

MR. LEE: One very brief thing. Your Honor wanted me to give you this, which is our --

THE COURT: Your witness list. Thank you. And Mr. Williams, feel free to go ahead. You remain under

oath.

GERARD WILLIAMS, DEFENDANT'S WITNESS, RESUMES,

MR. LEE: Very briefly, Mr. Dowd had something on the Papworth video.

THE COURT: All right. I'm happy to hear it.

MR. DOWD: Thank you, Your Honor. This is -- briefly. We're playing the video of David Papworth's deposition. We have some documents that we'd move to admit with that that are -- we're moving under 90 -- Rule of Evidence 902.11. They're self-authenticating documents. I have the declaration of David Papworth.

THE COURT: And have you shared that with opposing counsel?

MR. DOWD: We have shared that with opposing counsel.

THE COURT: And is there objection to that?

MR. SHEASBY: We just got it, I would say, an hour ago.

THE COURT: Let's do this: I will reserve as to those and if you want to provide me a copy now, that's fine.

MR. DOWD: Thank you, Your Honor.

THE COURT: And we'll all rise. Unless there's something more, we'll all rise.

MR. LEE: Nothing.

(Jury brought in courtroom at 8:37 a.m.)

THE CLERK: This Honorable Court is again in session. Please be seated and come to order.

THE COURT: Good morning, Members of the Jury. We're continuing with the direct testimony of Mr. Williams, who remains under oath.

Counsel, you may proceed when ready.

MR. LEE: Thank you, Your Honor.

CONTINUED DIRECT EXAMINATION

BY MR. LEE:

Q Mr. Williams, good morning.

A Good morning.

Q When we concluded yesterday, we were looking at DX 1656. Do you have that in the notebook before you? It's tab 6.

A Yes, I do.

Q If I could bring that up on the screen just to remind us of where we were. This is a patent issued to you and three others on your LSD predictor; correct?

A Yes, that's correct.

Q Now, are there a list of references that were before the Patent Office?

A Yes.

Q And if we went to the second page of the references, do you find the Moshovos '752 patent on that

list?
A Yes, it's right -- whoop. Right there.
Q Okay. Did you and your colleagues, in developing the A7 and the A8, receive other patents for the work and the inventions in the A7 and A8?
A Yes. There were around 70 other inventions that were awarded patents.
Q And those are in the A7 and A8; correct?
A Yes, that's correct.
Q Let's just take a couple of examples quickly. Turn, if you would, to tab 8 in your binder.
A Okay.
Q Can you tell us what this is?
A Yes. This is a patent at the SoC level regarding one of the security processors. It's called a *security enclave processor* that myself and a few others were awarded inside of Apple.
Q And it's U.S. patent 8,775,757?
A Yes. B2.
MR. LEE: We offer it, Your Honor.
THE COURT: It is admitted.
BY MR. LEE:
Q And does this describe work that you did in developing the A7 and aspects of the A7 and A8?
A Yes.

Q Turn, if you would, to tab 9. Tell what you find there.
A Yes. Another patent that was awarded to the CPU for the A7 design regarding memory accesses barriers that we convert to prefetches.
Q Is it patent number 8,856,447?
A Yes. Again with the extension B2.
Q And it's DX 1332?
A 1352.
Q 1352.
MR. LEE: We offer DX 1352, Your Honor.
THE COURT: It is admitted.
BY MR. LEE:
Q And if you could just put it on the screen, I just have one question. Does this relate to work on the A7 and A8?
A Yes, it does.
Q Does it describe inventions of Apple in the A7 and A8?
A Yes. One of them, yes.
Q Let me go to a different topic. Yesterday we were talking about fuse devices. Do you remember that?
A Yes, I recall.
Q Is there just one fuse in an Apple device?
A No. There are thousands of fuses in an Apple

device.

Q And in order for a device to actually operate, how many of the fuses have to be blown?

MR. FRISCHLING: Objection. Foundation.

THE COURT: I'll overrule. You can answer.

THE WITNESS: So there's actually a sequence of steps that you have to undertake. The first is after the device has been fabricated and bumped and packaged, then it's tested. When it's tested, a set of fuses are actually programmed for that given device to explain characterization properties about the device and features on the device. And there's basically two outcomes after you do this: There's an additional set of fuses within the device as well that lock down security access to, for instance, the phone so that when I as a user or you as a user purchase the phone, nobody can break into your phone. That distinct set of fuses that are available to be programmed demarcate whether or not you have an engineering sample, which the design teams within Apple first get in order to test the device without the security lockdown put in place.

And then there's a secondary thing which is once you blow those fuses, that's what ramps the production and that's what we as end-users purchase so that somebody can't break into your phone.

Q Now, did Apple provide samples to WARF for testing?
A Yes. Yes, they did.
Q Which fuses were blown and which fuses weren't?
A So the first set of fuses, it's the engineering sample configuration that was provided to WARF and that is the first set of fuses that every device actually has blown on it, whether it be production or engineering. The security features were not enabled so that you could actually connect up the debugger and the tools to the device and properly do things, manipulate it in certain ways.
Q And those were engineering test devices; correct?
A That's correct.
Q That allowed WARF to test the devices; correct?
A That's correct.

MR. LEE: Nothing further, Your Honor. Thank you. (8:43 a.m.)

THE COURT: Cross-examination. Mr. Lee, the second to the last exhibit, the second of the -- I have 1352, but I think it was indicated 1656. But I had already admitted that.

MR. LEE: Thank you, Your Honor.

THE COURT: Was that the exhibit?

MR. LEE: Can I check?

THE COURT: That's fine. You can advise me.

CROSS-EXAMINATION

BY MR. FRISCHLING:

Q Good morning, Mr. Williams.

A Good morning.

Q Who's in charge of manufacturing at Apple for the processors when they are made on silicon?

A The one individual or a company?

Q Let's start with an individual.

A That's the executive management team at Apple is actually in charge of that.

Q And who's on that team?

A Johny Srouji is one of the more senior people that's on that team. Mr. -- I call him Sri. We talked about him during the testimony. His name is Sribalan Santhanam is another member of the team. There are other senior people that will be involved with that from the architecture side as well as the physical side. Tim Malay is another. Myself as well will get involved at times with that. A gentleman by the name of Steve Polzine.

On the physical side you'll get individuals like Patrick McNamara, who we heard from today, and Fabian Claus is another one because he's a process expert. And various others.

Q So let me clarify the difference. The physical

side is the actual manufacturing of physical chips as opposed to designing the circuits that are going to go into them? Have I got that distinction right?

A It's a very -- that's a simplification, but yes, it's basically the process side versus the architecture design side and you need both together.

Q And so the two people that you identified that have responsibility at Apple on the process side were Mr. McNamara and Mr. Claus; right?

A Yes. And then I mentioned Sribalan Santhanam. He is a process circuits expert as well, too. But he's also their manager, so he would most definitely be involved.

Q So the folks at Apple that are involved in the process of actually making the chips, that's Mr. McNamara, Mr. Claus, and Mr. Santhanam, if I pronounced his last name correctly.

A Those are a few, yes.

Q Have you ever been to the Samsung factory in Austin?

A Not in Austin, no.

Q Now, sir, you recall yesterday you had talked a little bit to Mr. Lee about the amount of space on the die that the LSD predictor takes up?

A Yes. Yes, I remember that.

Q Very small amount; is that right?
A It's a very tiny amount, yes.
Q I think at some point had you calculated it to be something like .2 percent?
A I said yesterday it was much, much less than 1 percent and likely fractions of a percent.
Q And you'd agree with me, Mr. Williams, that when you're evaluating a feature like the LSD predictor for inclusion in a design, one of the things you look at is the amount of space it takes; right?
A We do that for every feature that we incorporate into the device, and the LSD was one feature, yes.
Q And you'd agree with me that when you're making that evaluation, the fact that a feature is small, that's a benefit; right?
A Anything being small is always a benefit, sir, yes.
Q In fact, you describe that as a beautiful benefit; fair?
A Yes, that was my testimony.
Q Now, you also recall talking about the fact that the LSD predictor consumes essentially negligible power; right?
A Yes, I remember.
Q In addition to consuming negligible power, the LSD predictor also avoids pipeline flushes; right?

A It helps avoid, yes.
Q And you'd agree with me that pipeline flushes are very expensive from a power and energy perspective.
A They're a negative impact. I don't know that I'd characterize them as very.
Q Well, sir, let's take a look at your deposition testimony.
MR. FRISCHLING: Could we please have Williams' depo 232, 13 to 235, 3 available on the monitors. And actually what I'd like to look at is 234, I think line 10. Could I have the next page, please. It's actually on 235. I'm sorry, go back, it spans the page. Forgive me.
Q The question and the first line of that paragraph says:
"Question: The Cyclone designs requires an expensive pipeline flush. What about the Cyclone design made its pipeline flush so expensive?
"Answer: As I just stated, it's the depth of the pipeline. So if you start from the beginning of the instruction, so you have N stages instruction fetch, you've got N stages into decode or M I should say, you have a few stages to execute. When you have to flush all the work through all of those stages and refresh it, it's expensive. It's potentially expensive from a

performance perspective. It's for sure very expensive from a power and energy perspective because you're throwing away a lot of work. And then there is -- and so you just don't want to do that kind of thing very often."

Did I read the testimony correctly?

A Yes, you did.

Q Mr. Williams, yesterday you recall talking about an estimate of the performance benefit of the LSD predictor that you'd given?

A Yes, I remember.

Q That was your estimate of in the range of 2 to 3 percent?

A That's correct.

Q And that was developed using an internal simulator at Apple called cSim; that was your testimony?

A cSim was used to model the pipeline of the processor and study the performance.

Q Now cSim, that's the same processor that Professor Reinman testified about that he wanted access to and didn't get; correct?

A Yes, I believe that's what was stated.

Q Now, you told Mr. Lee, if I understand or remember correctly, that Apple doesn't have records of those simulations anymore; correct?

A Yes, that's correct.
Q Did you ever write down your 2 to 3 percent estimate in a document of some kind?
A No, I did not.
Q So you never wrote the 2 to 3 percent in an email, for example.
A No.
Q You never wrote the 2 to 3 percent estimate in a report to your management.
A No, I did not.
Q Never put it in a journal publication; correct?
A No. I didn't publish any journals, no.
Q And didn't present it at a peer-reviewed conference of any kind.
A No.
Q Now, you were asked some questions about the '752 inventors and the simulations that they had done. Do you recall that?
A Yes.
Q And you were here when evidence came in that they, in fact, published their results in at least two papers before they filed their patent application. Do you remember that?
A Yes, I remember that.
Q Now, we've seen a lot of emails among Apple

engineers reporting performance data. Do you recall that?

A Yes, I do.

MR. FRISCHLING: Could we please have PX 58, which is already in evidence, up on the screen. And if we could just blow up the top portion of this chain, please.

Q So this is one of the emails from Mr. Meier to the Cyclone architecture group. Do you recall that?

A Yes, I do.

Q And if we look down in the second full paragraph, he's giving results on comparing a 9-bit tag to a 10-bit tag to an 11- or a 12-bit tag; right?

A He's comparing them to a baseline and that's the performance delta relative to the baseline.

Q And he's reporting performance deltas as small as 0.66 percent; right?

A Yes, that's correct.

Q Now, this is the sort of data that goes around by email among the Cyclone architecture engineers at Apple; correct?

A For this particular example, yes. There are various simulations that are run, and when the engineers study features, they will sometimes report some of the features that they're studying to inform the other

engineers about what's occurring.
Q But you didn't provide a single email to support your estimate of that 2 to 3 percent; correct?
A I didn't provide an email, but --
Q Thank you, sir. If you'd answer my question yes or no, I'd appreciate it.
A No, I didn't.
Q And you'd agree with me that -- well, actually let me go and take a look at an exhibit that you -- demonstrative you had put up yesterday. Could we have DDX 86, please. These are a variety of the features that you identified yesterday outside the LSD predictor. Do you recall that?
A I do, yes.
Q And you didn't provide in your testimony yesterday written documentation on the performance value from any of those; correct?
A Not specifically, no.
Q So I'm not going to go through all nine of them. But let me come back for a moment to your estimate. You would agree with me, sir, that the only way to verify your testimony about the LSD predictor giving 2 to 3 percent performance benefit would be by actually running the full cSim trace file suite; right?
A That and many other real world applications would

exhibit that property.

Q So sir, can you answer my question yes or no? In order to verify your testimony, you'd agree that the LSD predictor -- let me withdraw the question and try it again.

The only way to verify your testimony that the LSD predictor is giving 2 to 3 percent performance benefit would be by running the full cSim tray suite; correct?

A I wouldn't change my answer, sir. That would be one piece and then I would also run other applications as well on the device.

Q Could we please have your deposition testimony, if you'd take a look at it in your binder. Page 190, lines 21 to 25. Have you got that, sir? It's not up on your screen yet?

A No.

Q "Question: So the only way to verify your testimony that the LSD predictor is giving 2 to 3 percent performance benefit would be by running the full cSim trace file suite?

"Answer: Yes."

I read that correctly, didn't I?

A You did, and there's --

THE COURT: There's no need for you to amplify.

THE WITNESS: Okay. Yes.

THE COURT: The question was whether he read it correctly. I'd like you to listen to the question that he asks. And you may ask your next question.

MR. FRISCHLING: Thank you, Your Honor.

BY MR. FRISCHLING:

Q Apple still has the cSim simulator at Apple, correct?

A It does, yes.

Q Apple could have run the trace files as you indicated to verify the 2 to 3 percent performance; right?

A It could have run the tray suite, yes, just like I stated.

Q Thank you. Apple didn't do that for this litigation, did it?

A No, sir.

Q And Apple didn't allow WARF to do it either, did it?

A To use the simulator?

Q Correct.

A I believe --

THE COURT: I will simply advise the jury that WARF was given access to the various benchmarks but ultimately denied full access to the simulator for their experiments. And that's where the record ends. But

that's as far as we're going to go with that.

MR. FRISCHLING: Thank you, Your Honor. No further questions. (8:56 a.m.)

THE COURT: Any redirect?

MR. LEE: Very briefly, Your Honor.

REDIRECT EXAMINATION

BY MR. LEE:

Q So just two questions, Mr. Williams. For all the simulations that you ran that allowed you to come up with your estimate of 2 to 3 percent, is there any document at Apple that describes the final performance benefit of the LSD predictor alone at any percent?

A No. There's no document at all.

Q And if I -- last thing. I would like to complete your answer. Mr. Frischling read you a question on page 190 and then said your answer was yes. If we go on to 191, the rest of the answer was "That's the way we run the simulation to get performance increases for various features over the entire processor, we run the entire tray set." That was your answer; correct?

A I'll take your word for it because it's not in front of me. So yes.

MR. LEE: Thank you. Nothing further, Your Honor.

THE COURT: You may step down, Mr. Williams.

Thank you. Apple may call its next witness.

(Witness excused at 8:59 a.m.)

MR. LEE: Your Honor, our next witness is David Papworth from Intel who is going to testify by deposition. And the running time is about 25 minutes.

THE COURT: Very good. While the jury is listening to that transcript, I will speak briefly with counsel at sidebar.

(Discussion off record at sidebar 8:59-9:01 a.m.)

(David Papworth video deposition 8:59-9:20 a.m.)

MR. DOWD: Your Honor, at this point we would offer Exhibits DX 1630, 1631, and DX 721 through 75.

THE COURT: The Court will reserve on those exhibits.

MR. LEE: Your Honor, the first two were the ones in the video. I think the latter ones were the ones reserved on.

THE COURT: I understand. I am reserving on those exhibits and at the break we can address their admission.

MR. DOWD: Thank you, Your Honor.

THE COURT: Did you want to call your next witness?

MR. LEE: We do, Your Honor. Our next witness is Dr. David August. Mr. Dowd will do the examination.

DAVID AUGUST, DEFENDANT'S WITNESS, RECALLED,

THE COURT: Members of the Jury, as you know Dr. August is making a return visit to the stand. He remains under oath. You are aware of his general credentials.

And you may proceed whenever you're ready, Counsel.

MR. DOWD: Thank you, Your Honor.

DIRECT EXAMINATION

BY MR. DOWD:

Q Good morning, Dr. August. Welcome back.

A Thank you.

Q We've asked you back to address the damages issues. Have you considered the opinions from Dr. Conte, Dr. Reinman, and Dr. Annavaram in this case?

A I have.

Q Do you agree with them?

A I disagree with their conclusions.

Q So let's turn to those opinions.

MR. DOWD: If we can bring up Dr. Conte's Slide No. 23, please. There we go.

Q Now, do you agree with the opinion in this slide?

A No, I do not.

Q Let's turn to -- have you prepared a set of demonstratives to help explain why?

A Yes, I have.

Q Let's turn to DDX 11-4. What's shown here?
A So this is the A7 SoC floor plan.
Q Now, can you tell us whether the A7 has a memory subsystem?
A Yep. So the A7 has a memory subsystem separate from the processor.
Q What's contained in the memory subsystem?
A So this is going to be things like the caches, the memory controller, things that interface with the rest of the system's memory.
Q Has WARF accused the memory subsystem of infringement?
A No, it has not.
Q Can you tell us whether the A7 has any graphics subsystem?
A Yes. It also has a graphics subsystem.
Q What's contained in the graphics subsystem?
A So this will be things like the GPU, which is a graphics processing unit that's used for graphics processing obviously.
Q Has WARF accused the graphics subsystem of infringement?
A No, it has not.
Q Can you tell us whether the A7 has a display subsystem?

A It does.
Q What's contained in that subsystem?
A Controllers for the display, the devices display.
Q That's like the touch screen?
A The touch screen, yes. Exactly.
Q Has WARF accused the display subsystem of infringement?
A No, it has not.
Q Can you tell us whether the A7 has a camera and image sensor pipeline subsystem?
A It does.
Q What's contained in that subsystem?
A That's going to control the camera and also compensate for irregularities in the camera when you take a picture or a video.
Q Are you familiar with the Kingfisher CPU?
A Yes.
Q What is that?
A That's an ARM processor that's actually in that part of the -- in that subsystem.
Q And does that CPU have an LSD predictor?
A No, it does not.
Q Has WARF accused the camera and image sensor subsystem of infringement?
A No, it has not.

Q Can you tell us whether the A7 has a media subsystem?
A Yeah. It does have a media subsystem.
Q What does that do?
A That's going to process images and also movies.
Q Has WARF accused the media subsystem of infringement?
A No, it has not.
Q Can you tell us whether the A7 has a NAND subsystem?
A It does.
Q And what's contained in the NAND subsystem?
A So the NAND is the storage where your applications are. It's the storage that holds data when your phone is off, your permanent storage. And the NAND controller interacts with that memory.
Q Does that also have a Kingfisher CPU?
A It does.
Q Has WARF accused the NAND subsystem of infringement?
A No.
Q Can you tell us whether the A7 has a secure enclave subsystem?
A It does.
Q What does the secure enclave subsystem do?

A That's a separate part of the phone to hold your passwords and also your fingerprint when you use your fingerprint to get on, just so that it's separate and secure.

Q Does that also have a Kingfisher CPU?

A It does.

Q And has WARF accused the secure enclave subsystem of infringement?

A It has not.

Q Can you tell us whether the A7 has an I/O or input/output system?

A It does.

Q What does that do?

A So this is for getting data onto and off of your device. So, for example, the USB cable goes through this subsystem.

Q Has WARF accused the I/O subsystem of infringement?

A No, it has not.

Q Can you tell us whether the A7 has a power management subsystem?

A It does.

Q What does that do?

A This is going to control other devices, tell them when to sleep, other components within the system, when to slow down to conserve energy.

Q And has WARF accused that subsystem of infringement?
A No, it has not.
Q Now, can you tell us whether each of these subsystems and more provides value independent of the Cyclone core?
A I believe it does.
Q Can you tell us whether each provides value independent of the LSD predictor?
A They do.
Q And if you take all of these other processor cores together and compare that to Cyclone, what provides the majority of the value in the A7 system-on-a-chip?
THE COURT: The objection is?
MR. SHEASBY: Scope.
THE COURT: Paragraph?
MR. DOWD: It's in 61, Your Honor.
THE COURT: Paragraph?
MR. DOWD: 61, Your Honor.
THE COURT: Paragraph 61 of which report?
MR. DOWD: On the damages report.
THE COURT: Let's have a sidebar.
(Discussion at sidebar at 9:28 a.m.)
THE COURT: First of all, can we agree on the question that was asked? Your understanding of what

he's being asked is?

MR. SHEASBY: What's the majority of the value on the SoC.

MR. DOWD: And --

THE COURT: And where does he state -- do you agree that's the question you want him to answer?

MR. DOWD: I do. And that is the question. So in paragraph 26 he uses a summary opinion about the value. Paragraph 61 is where he said the same thing I just walked through about the --

THE COURT: Does he anywhere summarize what the value is as opposed to the other component parts? That's what your objection is to?

MR. SHEASBY: Yes.

MR. DOWD: I believe, Your Honor, paragraph 26 of his opinion provides that the --

THE COURT: Well, is he about to give a number or a percentage?

MR. DOWD: Not a number.

THE COURT: What is he going to say?

MR. DOWD: He's going to say that things outside the Cyclone provide the majority of the value.

THE COURT: He can say they've overstated their value, but he can't say it's the majority of the value because I don't opine him to that.

MR. DOWD: Okay. Thank you, Your Honor.

(End of sidebar discussion at 9:28 a.m.)

BY MR. DOWD:

Q Now, Doctor, the question was --

THE COURT: Well, why don't you just rephrase it and we'll go from there.

MR. DOWD: Thank you, Your Honor.

BY MR. DOWD:

Q Has Dr. Conte overstated the value attributed to the Cyclone CPU core?

A I believe by a number of technical metrics he has.

Q Thank you. Let's go to Dr. Conte's Slide No. 20. Were you here when Dr. Conte presented this slide?

A I was.

Q What does this slide tell you about the role of the CPU?

A So if you'll recall, he was using this slide to highlight the parts of the SoC outside of the processor that did work. So, for example, he was saying it was not the processor, it was other parts of the system that was primarily responsible for games, multimedia, and photos. So those things are going to operate and use parts of the -- the SoC that do not use the LSD predictor very heavily.

Now shaded, he was saying those were the parts that

involve the CPU. But if you look at the parts that are shaded, social networking, radio, retail, so that's going to Amazon, that kind of thing, instant messengers, these things do involve the CPU, but there's not CPU intensive. There's not a lot of computation involved in doing these kinds of things. So I think this supports the case that you can use this to understand the value of the processor in the device.

Q And so if we take the example of social networking and say I'm using my iPhone to go to Facebook to see a video that my family has posted, what part or parts of the A7 are used for me watching the video?

MR. SHEASBY: Objection. Scope.

THE COURT: You can answer the question.

THE WITNESS: Yes. So that's the media subsystem we talked about that was outside of the processor.

BY MR. DOWD:

Q Okay. And when you say that the area shaded in gray are not compute intensive for the CPU, does that mean that it's actually the portions outside of the CPU that are doing those things?

A Well, it means that -- well, it does mean that the CPU is involved, but for much of the time the CPU is actually sleeping. There's a little bit of work when

you type your text message and send it, but then between the key strokes the processor is going to sleep. There's nothing for it to do. Once the message is sent, it's waiting for the message from the person you're communicating with. It also will go to sleep. So I would consider that to have a very low-duty cycle so it's not a lot of code compute.

Q Now, how many processors other than Cyclone are there in the A7?

A Well, at least five that we counted.

Q Let's turn to DDX 11-5. What's shown here?

A So this is a Cyclone diagram and I have highlighted here the MDR, which is one of the components on Cyclone that we heard about last week.

Q How many transistors does Cyclone have?

A Cyclone has about 66 million transistors.

Q And if we go to DDX 11-6, what's shown here?

A So this is a subcomponent of the last slide, shown on the last slide, the MDR which I highlighted. This is blown up. And here you can see various components of the MDR. Within the MDR is the load-store dependency predictor shown here.

Q Does this LSD predictor make predictions for any processor core other than Cyclone?

A No. This is -- the impact of the LSD predictor is

limited to the Cyclone core.
Q So all of those other aspects that we looked at, the GPU, that Kingfisher CPU, are any of those affected by what this LSD does?
A No. It doesn't control them.
Q Let's go to DDX 11-6.
MR. DOWD: Advance the slide.
Q So what's shown here?
A So this is a table that shows the percentage of either lines of code of RTL that we heard about or of the die area of the chip, of the LSD, relative to the processor, the Cyclone processor, and also in the second column relative to the overall chip, the SoC.
Q So measured by lines of RTL code, what percent of the A7 SoC is the LSD predictor?
A Of the A7 SoC it's .6 percent.
Q What percent is it of the Cyclone, just the Cyclone itself?
A So just drilling down into Cyclone, it's 2 percent.
Q Measured by die space, what percent of the SoC is the LSD predictor?
A .2 percent.
Q And if we look just within the Cyclone itself, what percent?
A 1.17 percent.

Q Now, were the elements -- were there elements of the LSD predictor that were known in the prior art?
A Elements, yes.
Q And was the circuitry to execute instructions out of order known before the '752 patent?
A Yes. We heard that last week.
Q Was circuitry to detect data dependence known before the '752?
A Yes, it was.
Q Was circuitry to execute instructions speculatively known before the '752?
A Yes.
Q Was circuitry to recover from mis-speculations known before the '752?
A That was also known.
Q Was circuitry to make predictions --

THE COURT: Mr. Dowd, the jury heard all of this from this witness in the first part of the trial. We're not going to review it.

MR. DOWD: Thank you, Your Honor.

BY MR. DOWD:
Q Now, in addition to the prior art elements, can you tell us whether the LSD predictor contains Apple's own inventions?
A It does.

Q If we go to DDX 11-7, what's shown here?
A So this is the '725 patent. This is Apple's patent. The inventors are the engineers we heard about that developed the LSD predictor, and the owner of this patent is Apple.
Q And that includes Mr. Williams from whom we just heard testimony?
A That's correct.
Q If we go to DDX 11-9, what are you showing here?
A So this is claim 1 of the patent.
Q Of Mr. Williams' LSD predictor patent?
A That's correct.
Q Have you formed an opinion about whether Apple's LSD predictor practices this claim and is therefore covered by this patent?
A Yes. I've done the analysis.
Q What is your opinion?
A This covers the LSD predictor. It reads directly on the LSD predictor in the RTL.
Q How did you reach that conclusion?
A Well, I went element by element in the claim and for each element I went to the RTL and I found the -- well, at this point I was already familiar with the RTL so it was very easy to find the component that mapped each one of these limitations.

Q And has any WARF expert disagreed with your conclusion that Apple's LSD predictor practices Mr. Williams' '725 patent?

MR. SHEASBY: Objection. Scope and relevance.

THE COURT: I'll overrule it.

THE WITNESS: No.

BY MR. DOWD:

Q Now, I'd like to --

MR. DOWD: Can we blow up the bottom two limitations of the claim and focus on those for a minute. The ones down here.

Q Dr. August, if you could explain the last two limitations about incrementing and decrementing.

A Sure. So this is one of the key innovations that was recognized by the Patent Office.

MR. SHEASBY: Objection. Scope.

THE COURT: We'll have a sidebar.

(Discussion at sidebar at 9:35 a.m.)

THE COURT: Before I hear from you, Mr. Sheasby, is this in his report?

MR. DOWD: It is. It's paragraph 304 were he provides a claim chart that walks through every limitation.

THE COURT: I suspect you have a different objection than scope. I wish you would state it.

MR. SHEASBY: My objection is --

THE COURT: Relevance?

MR. SHEASBY: -- relevance. He mapped this element. This is the key impactor, a key thing the Patent Office considered. That's nowhere in his report and that's exactly what the Court --

THE COURT: I didn't hear him. Was he talking about the PTAP proceeding? I don't understand. I'm sorry, that who considered?

MR. SHEASBY: He said the Patent Office considered these two limitations as key limitations.

MR. DOWD: Actually that isn't what he said.

THE COURT: I didn't hear that either.

MR. SHEASBY: Yes, that's what I heard.

THE COURT: Well, I'll review it. If he did say that, I'll -- I will direct the jury not to consider it. We're not going to spend a lot of time on this because whether or not this infringes or reads on the other patent really doesn't matter for purposes of the jury's determination of damages.

MR. DOWD: I agree.

THE COURT: I've allowed Apple to continue to talk about other patents, other patents that applied to this chip because in an overall sense it shows that there's a lot of intellectual property. There has to be

some allocation to the specific invention. And I understand your objection. But then it wasn't to scope, it was move to strike and it should have been those two words.

And I'd appreciate it if we'd move this along. Thank you.

MR. DOWD: Thank you.

MR. SHEASBY: Thank you.

(End of sidebar discussion at 9:37 a.m.)

BY MR. DOWD:

Q Dr. August, I'd focus --

THE COURT: I'm sorry, I'm still --

MR. DOWD: Sorry, Your Honor.

THE COURT: To the extent that the witness testified that what he was talking about was a key element or a key distinction, you should ignore that testimony. That's not part of this case. But he can describe the basic components of this patented -- or this patented invention.

And you may proceed, Counsel.

MR. DOWD: Thank you, Your Honor.

BY MR. DOWD:

Q And that's really what I intend to ask. Just those last two elements, can you explain what they are and what they do?

A Yes. So these last two elements describe how the counter is incremented and decremented. What it's describing is that when the data ultimately is delivered from the store to the load, if it's delivered through one location, turns out to be the load-store queue, then the counter is incremented. If it's delivered through another location, through memory, then it's decremented. So what's going on here is an increment and a decrement, not based on dependence detection or mis-speculation detection, but based on the location that the data was delivered from.

Q Let's turn to DX 1656, which is the '725 patent itself. And if we could turn to page two. I'd like to look at the art that was considered. Could we blow up the top portion?

Doctor, can you tell us is the WARF '752 patent listed on the list of prior art that the Patent Office considered?

A It is.

Q And did the Patent Office grant Mr. Williams his LSD predictor patent over the '752?

A Yes.

Q Is Dr. Moshovos's 1997 ISCA paper listed on the list of prior art the Patent Office considered?

A It is. It's not shown on this screen. It's down

lower.

MR. DOWD: Could we go down to that.

Q Would you identify that for us? You've identified for us the 1997 ISCA paper?

A That's correct.

Q Did the Patent Office grant Mr. Williams' LSD predictor patent over Dr. Moshovos's 1997 paper?

A Yes, it was before them.

Q If we go back up to the top left, did the Patent Office consider the Hesson prior art reference? Did it consider the Steely prior art reference?

THE COURT: I'm not sure you had an answer to your question.

THE WITNESS: Yes. It considered both Hesson and Steely.

MR. DOWD: Thank you, Your Honor.

BY MR. DOWD:

Q And was Mr. Williams' LSD predictor patent granted over both of those as well?

A Yes, it was.

Q Let's turn back to DDX 11-11.

MR. DOWD: If we could go to Slide 11, please.

Q While that's coming up, is Mr. Williams' LSD predictor patent the only patent that Apple has on the A7 and A8 chips?

A No, it's not.
Q What are you showing here on Slide 11?
A This is another patent. Here the only inventor is Gerard Williams.
Q So what does this patent cover?
A So this is converting memory accesses to near barriers into prefetches. So this is actually a different kind of speculation. It's not load-store dependence speculation, it's a different kind of speculation that's used in the processor.
Q Have you analyzed whether the A7 practices Mr. Williams' '447 patent?
A Yes, I have.
Q What have you concluded?
A It does practice.
Q Has any WARF expert disagreed?
A No.
Q Let's go to DDX 11-12. What's shown here?
A This is another Apple patent called *Inline Image Rotation*.
Q What does this patent cover?
A So this is part of the multimedia subsystem that will allow you to scale and rotate images efficiently.
Q Have you analyzed whether the A7 practices the '359 patent?

A Yes.
Q What have you concluded?
A It does.
Q Has anyone disagreed?
A No.
Q Let's go to DDX 11-13. What is shown here?
A This is a patent. You'll notice Gerard is on this one as well owned by Apple called *Trust Zone Support in system-on-a-chip having Security Enclave Processor*.
Q And what does this patent of Mr. Williams', the '757 patent, cover?
A This covers an aspect of the secure enclave processor. We talked about that earlier about it's the part of the processor that keeps your passwords secure and your fingerprint secure.
Q Have you analyzed whether the A7 practices Mr. Williams' '757 patent?
A I have.
Q What have you concluded?
A It does practice.
Q And has any expert from WARF disagreed?
A No.
Q Let's go to DDX 11-14. What's shown here?
A This is another patent covering the secure enclave processor.

Q Is this the '747?
A Yes.
Q What does this patent cover?
A This covers a different aspect of the secure enclave processor. So the secure enclave processor is very complex. So this is another patent that covers a separate aspect. The first one is more about the communication. This is more about how you manage passwords and encryption.
Q Have you analyzed whether the A7 practices the '747?
A Yes.
Q What have you concluded?
A It does.
Q Anyone disagree?
A No.
Q Let's go to DDX 11-15. Finally, I'll ask have you analyzed whether the A7 covers, or sorry, whether the 6 -- withdrawn.

Have you analyzed the '465 patent?
A Yes, I did.
Q And is this another patent that is secure enclave practices?
A Yes.
Q Has anyone disagreed with that?

A No.
Q So let's go to DDX 11-16. What are you showing here?
A So I went through a large number of patents. I found at least 70 that cover processor technology. Of those, 40 -- at least 40 are related to instruction execution within a processor.
Q And these are all patents owned by who?
A They're all owned by Apple.
Q Let's go to Dr. Conte's Slide 12 actually. And do you recall that Dr. Conte talked about some patents from the Apple v. Samsung litigation?
A Yes, I remember that.
Q And he suggested during his direct examination that these Apple patents were comparable to the '752. Do you agree with him?
A No, I don't agree.
Q Let's go to DDX 11-36. What's shown here?
A These are some of those patents.
Q Now, let's just talk about the patents that Dr. Conte talked about. Is the technology in Apple's '381 patent, the bounce back patent comparable to the '752?
A No.
Q Why not?

A Well, the bounce back patent, that's when you're scrolling, you get to the end, and it kind of bounces to indicate that you're at the end of maybe the top of your email or the bottom. That's something that a user experiences. That's, you know, going to be -- it's really like a wow factor the first time you see that. That's part of the experience. I don't think that's the same as one of many patents that cover some performance gain in a processor.

Q Was this bounce back patent, was that in the very first Apple iPhone?

A Yes, it was.

Q So did Apple invent this bounce back patent, before the A7, before the LSD predictor, before any of the things that issued in this case?

A Yes.

Q Let's turn to the technology in Apple's '721 patent, that slide-to-unlock patent. Is that comparable to the '752?

A No, I don't think it is.

Q Why not?

A Again, it's really about the experience. It's about solving a problem. In this case it's, you know, having a phone in your pocket that's doing things that you don't intend like pocket dialing. That's going to

change the user experience. That's something that users care about. I think it has more value than one of many patents that impacts the processor performance.

Q So does the slide-to-unlock patent have anything to do with out-of-order processing or any of the technology we've been talking about?

A No.

Q Was the slide-to-unlock patent, was that also invented for the first iPhone before any of the LSD issues that we're talking about here?

A Yes.

Q Is the technology in Apple's '172 patent, that was the autocorrect patent, is that comparable to the '752?

A No.

Q Why not?

A For the same reason. It's correcting your spelling. It's helping you communicate. That's something that you feel. Again, I don't think that's comparable to one of many patents that impact performance of the processor.

Q And was the autocorrect patent, was that invented before the LSD --

A Yes.

Q -- predictor? Is the technology in any Apple patent from the Samsung litigation comparable to the

'752 patent at issue here?
A No.
Q Was any of the patents -- were any of the patents in that litigation about out-of-order processors?
A No.
Q Were all of those patents invented before the LSD predictor of the A7?
A They were.
Q Let's turn to your opinion on performance testing. I'd like to start with what did WARF's experts compare in this case?
A So they compared -- they used an actual device, an engineering device, and they compared the device with the LSD predictor against no predictor at all and measured that performance difference.
Q And do you agree that the correct comparison is the LSD predictor versus no LSD predictor?
A No. I think there are better alternatives to just ripping out the predictor and leaving nothing behind.
Q Does comparing the LSD predictor to nothing, does that overstate or understate the performance benefit and value attributable to the '752 patent?
A I think that's going to overstate because you would put something in there in place of the predictor. You'd use a different predictor. We've seen many different

predictors, and those predictors would naturally perform better than no predictor at all.

Q So what is the correct comparison that should be made?

A Well, I think you want to look for the current predictor, the accused predictor, and the best alternative I think is the right measure.

Q Now, using WARF's approach, the LSD predictor to nothing, what happens to the value provided by Apple's patents like the '725 patent that Dr. Williams has on the predictor?

MR. SHEASBY: Objection. Scope and relevance.

THE COURT: I'm going to overrule it. You can answer -- you can answer that question.

THE WITNESS: Yes. So to the extent there's any additional innovation in the LSD predictor, that's also factored out when you remove the predictor entirely.

BY MR. DOWD:

Q And so is WARF claiming the benefit provided by Apple's innovations as a part of its case?

THE COURT: Is this a scope objection?

MR. SHEASBY: Yes.

THE COURT: Is there a specific reference you can give me?

MR. DOWD: I'll rephrase, Your Honor.

THE COURT: Thank you.

BY MR. DOWD:

Q So in making the comparison, you said that the correct comparison would be LSD predictor to alternative. Do you recall that?

A Yes.

Q Should you include in the comparison, should you include in the value that you attribute to WARF, in this case things like the value of what Mr. Williams invented in the '725?

THE COURT: I'll sustain that objection as calling for a legal conclusion. And you may ask your next question, Counsel.

MR. DOWD: I understand, Your Honor. Thank you.

BY MR. DOWD:

Q Did any WARF expert in this case compare the performance of the LSD predictor to a prior art predictor?

A No.

Q Did any WARF expert in this case compare the performance of the LSD predictor to a noninfringing alternative predictor?

A No.

Q Did any WARF expert in this case -- withdrawn. Did any WARF expert in this case attempt to back out of the valuation, the value of Apple's innovations?
A No.
Q Now, have you helped to prepare a demonstrative to explain the various types of performance testing that exist?
A Yes, I have.
Q Let's go to DDX 11-17. And what are you showing here?
A I think it's useful to understand that there are different ways of doing testing, because I think a lot of that is getting confused. And what I've shown here are the three primary ways in which testing is done and that we've seen -- well, some of which we've seen so far.
Q So let's start with the first on the left. What are server benchmarks?
A So server benchmarks, these are benchmarks that assume a full-duty cycle. They're the kinds of things that run on high performance machines. They're going to run in data centers, desktop machines. They're really trying to characterize what people do on their desktop or in the data center.
Q And is a server in a data center, is that different

from a mobile device like an iPhone?
A Dramatically. I mean the data center has an enormous amount of power, electricity that they can use. There's higher performance processors are in these servers. The things that they run are just very different from the kinds of things that we run on our phones.
Q Is there a difference in terms of the amount of memory?
A Sure. Each server -- so a data center will have many, many servers. Each server will have much more memory than a phone, much more memory bandwidth, how much data it can transfer to and from memory.
Q Is there a difference in terms of the number of loads and stores?
A Yes. That translates into a big difference in the number of loads and stores per second.
Q Can you give us some examples of server benchmarks?
A Well, we've seen two so far. There's the SPEC benchmark suite and also Dhrystone.
Q Now, what are user device benchmarks?
A So these are -- we're now getting to benchmarks which are more relevant to a mobile device. These are programs that you can download from the app store. They will run a series of tests automatically and put a

number on the screen and then you can use that number to compare one device to another device.

Q And why were user device benchmarks created?

A Again, it's really to compare device to device.

Q Can you give us some examples of user device benchmarks?

A Yes. We've seen one so far which is Geekbench. You've heard about that. But there are some others: Basemark X, LINPACK and 3DMark. You can get those from the app store as well.

Q We'll come back to those in some more detail. But could you explain what your third category of performance testing, this user experience?

A Yeah. I think this is actually a really important category because what you really want to understand to understand the value of a component in a phone is how does it impact the user experience. And for that, let's just use real Apple locations. Put the benchmarks aside, they really aren't even benchmarks. Benchmarks are a proxy for this. They want to give you an idea of how the actual applications work. There's no better way than to use the actual applications themselves.

Q So something like -- can you identify some of those user experience-type applications for us?

A Yes. So these are -- I would think that we're all

more familiar with a camera application, Kindle, Book Reader, Safari, the web browser, Candy Crush, the game, and a music player.

Q So can you actually compare the actual user experience on one of these applications with the LSD predictor on and off?

A That's what I did.

Q Let's go to Dr. Conte's Slide 11, please. What's shown here?

A Dr. Conte put this slide up to indicate what kinds of things are important, and I should mention this is an email, an Apple email, internal email that's describing that performance improvement would be desired in activities like launching apps, loading attachments, launching the camera, time to first camera shot, open photo library, things that -- various user interface navigation activities. This is again related to what the user actually experiences.

Q And so this is an email you mentioned that Apple's director of marketing Kaiann Drance wrote?

A Yes.

Q And is she focused on things like benchmarks or is she focused on the actual operation of the applications?

A On the actual user experience, which I think she's saying that's what's going to sell the product.

Q And so how does this relate to the performance test that demonstrate the user experience?
A Well, I think that the best way to understand the user experience is to use actual applications and measure that experience and this is -- we can do that. We have the phone as it's been produced. We don't need to use simulators or anything like that. We can actually use real applications on a real device.
Q So if we go back to Slide DDX 11-17, is the performance testing of the user test on the right, is that testing the actual experience of the user on the same application, same types of applications Ms. Drance identified?
A I think it's much, much closer to how the user is going to experience the phone than any benchmark.
Q So we'll come back to that in a moment. Let's turn to the benchmark tests that Dr. Reinman ran.
MR. DOWD: If we could bring up Dr. Conte's Slide 40, please.
Q What's shown here?
A So this is a slide discussing the controversy around Dhrystone. This is Dr. Conte's slide.
Q And what type of benchmark is Dhrystone?
A So I've put that in the -- that's the category of a server benchmark. This was developed in the 80's when

there was no such thing as a smartphone. It was for machines that, you know, would take up rooms.

Q And can you tell us whether Dhrystone has been criticized in the industry?

A Almost universally.

Q Let's go to DX 1475. This is that Weiss article that I asked Dr. Conte about. Are you familiar with this article?

A Yes.

Q What is it?

A This is an article about Dhrystone. By this point, Dhrystone was considered to be overused and some people were concerned about that.

Q And this was written in 2002. So this concern arose already more than a decade ago?

A Yes.

MR. DOWD: Let's turn to page three. And if we could blow up the bottom paragraph in the bullets, please.

Q Can you tell us whether computer architecture has changed since Dhrystone was created in 1984?

A Computer architecture is a fast-moving field. It has changed dramatically. The processors we had back then are nothing like what we have today.

MR. DOWD: And if we could just highlight the

last sentence before the bullets.
Q It says "Dhrystone doesn't take into account any of the following:" I'd like to identify some of the things that it doesn't take into account. Does Dhrystone take into account the RISC, R-I-S-C, architecture?
A No, it does not.
Q That's the first on the list. Is A7 a RISC architecture?
A It is.
Q Does Dhrystone take into account superscalar designs?
A No, it does not.
Q Is A7 a superscalar design?
A It is.
Q Can you tell us whether Dhrystone takes into account large memory subsystems?
A It does not.
Q Is A7 -- does it have a large memory subsystem?
A Yes.
MR. DOWD: I'd like to really focus on the last bullet, if we could highlight that.
Q Does Dhrystone take into account graphics, multimedia, and communication-intensive applications?
A Not at all. Doesn't do any of those things.
Q What are the major purposes of a smartphone like an

iPhone?
A Well, many people use them for graphics, games, multimedia, watching movies, things like this.
Q Things like making a phone call, like a communication?
A That would be communication, yes.
Q And so does Dhrystone -- is it appropriate for testing a chip that's being used in a smartphone?
A No, not at all.
MR. DOWD: Let's turn to page four. And if we could blow up the portion at the top, please.
Q Now, what does the creator of Dhrystone, Dr. Weicker, say about its usefulness for modern CPUs and workloads?
A So this is the creator of this benchmark. He says it -- it's not useful for modern workloads and CPUs. It's just not --
MR. DOWD: Highlight that, please.
Q And what are the reasons?
A For many of the reasons we already talked about. It just doesn't take into account a lot of the features of modern processors.
Q Okay. So is Dhrystone appropriate for evaluating the A7?
A I don't think so.

Q Let's go to Dr. Conte's Slide No. 38. What's shown here?
A So this is the second server benchmark that we talked about. This is called SPEC, and SPEC is a collection of several dozen smaller programs that are intended to be run together.
Q When was SPEC developed?
A In the 80's.
Q Is that before the smartphone and tablet era?
A Yes.
Q What type of benchmark -- I believe you told us already that this is a server benchmark?
A That's correct.
Q Approximately how many benchmark tests are there in the SPEC suite?
A Well, in the SPEC suites that we've talked about so far in this case there are several dozen.
Q Did Dr. Reinman test all of the SPEC benchmarks?
A No. He selected -- actually he was given direction to only look at seven of these.
Q Let's go to your Slide DDX 11-19. What's shown here?
A So these are the tests performed by Dr. Reinman, and you're seeing here the seven that he tested and the results that he obtained.

Q Now, did you perform any SPEC benchmark testing to check Dr. Reinman's work?

A Yeah. To check his work I reran the same seven, but I also ran as many as I could. Something to keep in mind here is that this benchmark wasn't intended to be run on something like an iPhone, so many of the programs would simply not run on the iPhone. And so I just ran as many as I could run to get a better picture than we had with seven.

Q And can you tell us how many you ran in total?

A 27.

Q And for the extra benchmarks that you weren't able to run, can you tell us exactly why you can't run them on a processor like the A7?

A There were two main reasons. The first reason is that the iPhone doesn't have the same kind of memory that a server does in terms of quantity. So some of these programs needed more memory than was available in an iPhone.

The second reason is that many of these programs were written in a language that was made for scientific computing and is not supported on an iPhone. So the programs are just in a language that just won't translate or compile down to an iPhone.

Q Now, let's pause on that for a second. What does

the fact that SPEC is written in a language that's not useful for the iPhone and has these other problems, what does that tell us about whether SPEC is appropriate as a benchmark for use in this case?

A Yes. So to be clear, it's the programs that I couldn't run that were written in a language called FORTRAN. The fact that we weren't -- it's not possible to get them to run I think strongly suggests, if not proves, that this is not appropriate for iPhone testing.

Q Okay. Let's focus for a moment on what we are able to do with SPEC. If we go to DX 1608, please. That should be at tab 5 in your binder, Doctor. Do you have that?

A Yes.

Q Do you recognize DX 1608?

A Yeah. This is my spreadsheet where I tabulated the results.

Q And how did you record the results that you got when you ran your tests?

A So the first thing I did -- any time I ran a test, I either recorded a video or took a screen shot so that everything was recorded initially. Then I would use those screen shots and videos to get the numbers out and put them into the spreadsheet so that I could then do additional calculations on the numbers.

Q And if someone wanted to verify your results, how would they use DX 1608 to do so?
A Well, there's two things. One is they could look at my videos and screen shots and compare the numbers that were in those pictures or videos to see if they were correctly typed into the spreadsheet. The other thing they could do is for any of these tests, they could rerun that test, and rerunning that test, they could come up with their own result and they could see if their result was the same as my result.

MR. DOWD: And Your Honor, we offer DX 1608.

THE COURT: It is admitted.

BY MR. DOWD:

Q Now, Dr. August, have you prepared a demonstrative that plots your SPEC results against Dr. Reinman's?
A I have.
Q Let's go to DDX 11-20. What's shown here?
A So I've added -- so this is similar to what we saw before. The *tested by* Dr. Reinman is in red. The -- which I also reproduced. And then I also did the additional ones in blue and added them to the same chart.
Q Now, how do your SPEC results compare to Dr. Reinman's?
A So I was surprised to learn that the seven that

were selected by Dr. Conte were all -- showed a larger difference between predictor and no predictor. They were all toward the left side here, and that most of my additional testing of the additional parts of SPEC came in much lower.

Q Did you ever learn why Dr. Conte and Dr. Johnson chose the seven benchmarks that showed the highest difference?

A I didn't know when I did this why. But when I shared these results with their experts, they then said that it was because they were doing divot testing. They were saying they were intentionally going for the worst case.

Q And so does that -- what does that mean with respect to overstating the actual performance difference?

A I believe that overstates the results and is not a fair representation of what's happening.

Q And why is it that Dr. Reinman's selection of seven benchmarks to test is not a fair presentation of the performance difference attributable to the LSD?

A Well, SPEC was in -- several reasons, one of which the SPEC was intended to be run in its totality. We can't do that because we can't get all the programs to run. But we want to get close to that. We want to be

true to the benchmark and run as much as we can. When you do that, you get closer to what -- at least what SPEC is measuring. But for other reasons I don't think SPEC is the appropriate measure.

Q And let's say we were to apply the same approach. If we just took the bottom seven of yours, what sort of performance difference would you have?

A Yeah. So if I just picked the bottom seven, I mean the results would be close to 0. So, you know, I didn't do that. I don't think that's fair.

Q Okay. Let's turn to Dr. Conte's Slide 52. Were you here when Dr. Conte presented this slide?

A Yes.

Q And what did Dr. Conte conclude about whether Dhrystone and SPEC should be used in this case?

A So he said that they should be -- they shouldn't be used. He says do not use the higher SPEC and Dhrystone numbers.

Q Let's go to your slide DDX 11-32. What are you showing here?

A So this is showing a number of things here. So the first thing is the three different categories of tests. We have at the top the server benchmarks, the user application benchmarks, and finally the app testing in different rows. And the big -- it's really a Venn

diagram. This is what I tested, all of these, and this subset here labeled WARF is what WARF's experts tested.

Q So just to make sure we've got it right, everything in the larger blue circle you tested?

A That's correct.

Q And just the portion in the smaller red circle is what Dr. Reinman tested?

A Yeah, just those three.

Q And what does Dr. Conte say about the server benchmarks at the top?

A He says don't use these.

Q Okay. So what is the only benchmark suite that Dr. Conte actually uses?

A So then they're just left with Geekbench.

Q And is it appropriate to rely on a single set of benchmarks to demonstrate performance differences?

A No. I think you want to take as many -- you want to do as many tests as possible. One test may not, especially a benchmark, may not be representative of what's going to be ultimately the user experience.

Q Why is that especially true of benchmark?

A Well, because a benchmark is really a proxy for something else and it's -- for those reasons, it's not going to be by itself. It's not going to cover all different kinds of behavior you'll see on the phone.

It's not going to be as true to the user experience.
Q So let's turn to the testing that you performed. What types of tests did you perform?
A So in addition to rerunning the results, the experiments that Dr. Reinman performed, I also ran some additional user application benchmarks and I also did some application testing.
Q So let's start with the user device benchmarks. If we go to DDX 11-21, please. What's shown here?
A So these are the additional user application benchmarks that I ran. They include Basemark X, LINPACK, and 3DMark.
Q What is the Basemark X benchmark suite?
A This actually -- so video games have what's called a video game engine embedded inside them. This Basemark X includes what's called the Unity engine, which is the most popular video game engine used in games on the iPhone. And so this will give you an idea of how the iPhone performs for games. This is also the most popular user benchmark in the world.
Q So why did you choose to test the Basemark X benchmark suite?
A I wanted to see -- I wanted to increase understanding of how applications perform through the use of these benchmarks, but this will cover things like

video games which are very important to many people.
Q And what did your testing, using the Basemark X benchmark suite, show to be the performance difference between having the LSD predictor and not having the LSD predictor?
A So taking out the LSD predictor and not replacing it with anything else, you get a .12 percent performance loss.
Q And has anyone disputed that Basemark shows a 0.12 percent performance difference between these two?
A No.
Q Let's go to the next benchmark, LINPACK. What is that?
A So LINPACK does some what's called *floatingpoint computations*. The floatingpoint is anything that's going to involve fractions of numbers. It's going to do a lot of floatingpoint arithmetic meaning multiplication, division, that kind of thing.
Q Why did you choose to test the LINPACK benchmark suite?
A A lot of those computations are used in optimizers and other things that are part of other applications, real applications.
Q And does the A7 perform floatingpoint operations?
A Yes, it does.

Q Now, what was the performance difference that you measured using the LINPACK benchmark suite between use of the LSD predictor and no LSD predictor?
A Yes, so this was interesting. When you remove the LSD predictor, the processor goes faster. So the way that's shown here is as a negative .51 percent.
Q So the result of removing the LSD predictor for floatingpoint operations is actually it improves them?
A Yeah. So actually predictors can be wrong and when predictors are wrong and when they're wrong a lot, they can create a different kind of performance divot in the other direction.
Q Now, the third benchmark that you ran is called *3DMark*. What is that?
A This is a graphics benchmark. This is going to stress the multimedia system.
Q And why did you choose to test the 3DMark suite?
A So again, graphics are important. I should say this also stresses the GPU, so a lot of graphics processing. You might see any time you're manipulating a 3D image or something like that, you're doing a lot of graphics processing or rendering in a video game. So that's why I added that to the list.
Q And what was the performance difference with 3DMark?

A 4.41 percent.
Q Now, did WARF's experts run any of these tests?
A No.
Q And are all of the tests lower than the results from Geekbench?
A Yeah. Just among the user application benchmarks, every single one I tested was lower than Geekbench.
Q Let's turn to the user experience and go back to Dr. Conte's Slide 11. This was Ms. Drance's email and you said that you performed tests to measure the performance difference experienced by users. I'd like to turn to those specific tests now.
MR. DOWD: Could we bring up DDX 11-22.
Q What's shown here?
A So these are the five actual applications that I measured. This is, I believe, the most representative of what the user is going to experience.
Q And can you just identify for us for the record what those specific applications were?
A Sure. The camera application; Kindle, which is an e-book reader; the music application, which is going to play music; Candy Crush, a video game, very popular; and Safari, the web browser.
Q How did you select these applications to test?
A Well, Candy Crush was easy. Dr. Reinman had

actually downloaded it, described that he had downloaded it and tested it. But he didn't take any measurements. I wanted to actually take a measurement. But then I started with a larger set and what I had to do was filter some out because a lot of them had -- would work -- really their performance was related to what kind of network you were on. Were you on wi-fi? Were you on the radio? How fast, you know, for example --

MR. SHEASBY: Objection. Scope.

THE COURT: I'll sustain that objection unless you -- there's some specific reference to this example.

MR. DOWD: Your Honor, I can rephrase.

THE COURT: Thank you.

BY MR. DOWD:

Q So just focusing on these five, was there something about these five that you thought would be particularly useful to test?

A Yes. So these were outside of other factors like communication. These would be repeatable. You'll get the same result. Because it was important to run each of these ten times, each experiment ten times to make sure that there weren't any transients. It was just very consistently the same.

Q Okay. Let's go to DDX 11-42. What are you showing here?

A So this is what's called a *Tapster robot*. So when you have a benchmark, you don't need a robot because the benchmark is going to run a synthetic test or a program automatically and it's going to internally measure -- it's internally running. It's internally measuring how long it takes, and then it just gives you a number. It's really easy and that's why we use benchmarks.

To actually use real applications, I have to account for the user. The user is going to be interacting with the touch screen. And the way to do that in a fair way, in a repeatable way, I used a robot. I could program the robot to take -- to perform the same actions every time and that way I'm doing a fair test run after run.

Q So with the robot, can you control exactly when the program is going to be touched? When it's going to start?

A Yes. So I program the robot to, let's say, move -- there's like a mechanical finger here. You can move the finger to a particular point. Here it's Candy Crush. So I tell it to move to a specific location and push the play button. The play will start. Then I have the robot actually go through, in this case, the tutorial and it can move candy pieces around to actually experience the tutorial, for example.

Q Using the robot, can you do it exactly the same way with the LSD and without the LSD?
A The robot is computer controlled, so within milliseconds it's doing the same thing every time.
Q And how did you capture the data that you generated using this testing?
A So because I don't have the -- here these aren't benchmarks, it's not going to tell me how long it took. I used a high-speed camera and the high-speed camera was 100 frames per second. So I could review the video after the fact and see which frame a particular event occurred. So what frame in the video did the robot touch the button; what frame did, you know, the application load. And from that I can compare frame to frame and figure out exactly to hundredths of a second how much time each event took.
Q And so did that allow you to actually compare the performance time with the LSD to the performance time without?
A Yes. So I would do that once with Mode 0 with a predictor and once in Mode 3 without the predictor and I could do a comparison.
Q Did you capture all this data, these videos, did you preserve all that?
A Yeah. I saved all the videos and I provided those

to WARF experts.
Q And if you could turn in tab 12 to DX 1582. It's in your binder -- I'm sorry. If you could turn in your binder to tab 12. You should have the DX 1582 sheet.
A Well, it's just a cover sheet.
Q Yes. But can you tell us whether DX 1582 is actually the videos that you captured.
THE COURT: It's intended to represent the videos.
THE WITNESS: Oh, I see.
THE COURT: And the Court will just take judicial notice that those videos are part of the record here.
MR. DOWD: Thank you, Your Honor.
THE COURT: And you wish to move their admission.
MR. DOWD: We offer them, Your Honor.
THE COURT: I will allow it. It is admitted.
BY MR. DOWD:
Q So I don't want to go through all the videos, but if we could just do one. If we could pull up DDX 12-2. Before we begin, what are you showing here, Doctor?
A So this -- so this is actually two videos that were then made into one video for the purpose of illustration. So on the left, I have the device, the 6

plus in Mode 0. That's with the predictor. That's just one video. The Tapster robot is going to interact with the Kindle application after it loads it.

The other video is without the predictor performing the same task. Now, we've taken both of those videos and we've put them side by side so you can have the benefit of seeing how they perform together simultaneously. So this helps exaggerate or make more noticeable any difference in the timing.

Q And if we could run the video, and Doctor, if you could explain to us what happens along the way.

A Yes. So at the start, the robot is going to activate or load the Kindle app. There it did it. It's going to go through the program -- I'm sorry, the document that's included with the Kindle app, it's going forward through the pages. Now it's going back through the pages. And in this case, you can see that the timing is very similar. The videos are very similar because the timing is the same and pretty much everything is happening in the same way except one, the predictor is on and the other predictor is off.

Q So based on this, what were you able to conclude about whether the presence or absence of the predictor had any actual impact on the user experience?

A Well, here the impact was minimal.

MR. SHEASBY: Objection. Scope.

THE COURT: I'll allow it briefly. You can describe what the video shows.

THE WITNESS: Yes. So when you go down to the -- and this is in the recorded numbers. When you go down to which frame each event occurred, there was little difference between, if any, between the number of frames that elapsed between each event.

BY MR. DOWD:

Q I'm just looking at your report, Doctor, at paragraph 218. Was the performance delta approximately minus .12 percent?

A Yes. So specifically that's for average load time. So, in fact, it was faster to load the program without the predictor than it was to load the program with the predictor.

Q If we go back to DX 1608, the summary table of your test results -- sorry, that was DX 1608. That should be at tab 5, Doctor, in your witness binder.

Taken together, what was the performance difference attributable to the LSD predictor in your user applications tests?

A It was less than 1 percent.

Q So let's compare the results of the tests that WARF's experts performed to the tests that you

performed. If we go to DDX 11-25. What's shown here?
A So I've expanded -- so this is the -- this chart is showing the test run by Dr. Reinman.
Q It's adding the additional SPEC test of Slide 26?
A These are the additional SPEC tests with room for some more tests that we're going to show in the next slide.
Q And just based on the adding of the SPEC alone, can you tell us whether the numbers that WARF is relying on are a fair presentation of the performance difference?
A Certainly for the server benchmarks, the results provided by WARF's experts overstate the average.
Q If we go to Slide 27, what's added now?
A So now we're adding the additional user benchmarks, user device benchmarks, and you'll see that they all fall to the right of Geekbench.
Q What is this trend line showing?
A So it's showing now that Geekbench was the most favorable measurement among the user device benchmarks.
Q And the ones that you ran are greater or lesser than that?
A The ones that I ran show a lesser difference between having the predictor on and having the predictor off.
Q If we go to DDX 28, 11-28, what are you showing

here?
A So here these are the results of using actual applications with the robot with the high-speed camera, and most of those, if not all of them, fall to the right, very right of this chart. So they're all lower than Geekbench.
Q What does your application testing say about the performance difference between the LSD being on and off?
A For real applications, it's less than 1 percent.
Q Let's go to DDX 11-30. What are you showing here?
A So this is highlighting the set of test results that Dr. Conte says do not use.
Q Now, did Dr. Reinman report any performance test results lower than Geekbench?
A No, he didn't.
Q And is it appropriate to ignore those test results?
A Well, yeah, if you had those results, you should not ignore them.
Q Can you tell us whether reliance on a single set of benchmarks to the exclusion of all of these others, all these others over here is reliable?
A Well, I think if you're going to use -- it seems nonscientific to just take one measurement and consider that done, which is really what we have with Geekbench after SPEC and Dhrystone have been thrown away. You

want to test more and more to get a better picture of what's really happening.

Q And as you test more and more to get a better picture of what's really happening, what does that show you about the actual performance difference?

A So as I -- and I did that. As I tested more and more, it seemed like there was a trend in the performance down to the 1 to 3 percent range.

Q Now, were you here when Mr. Williams testified that based on his internal experience with the design team, the LSD predictor contributes somewhere in the order of 1 to 3 percent performance?

A I thought he said 2 to 3 percent.

Q Sorry. 2 to 3 percent. Is that consistent with the testing that you performed?

A Yes. So as we test more and more programs, user device benchmarks and applications, we're getting in that range. I find that range to be credible.

Q Let's turn to the Intel products. There's been a lot of discussion about Intel and we just heard from Mr. Papworth about memory disambiguation. You were Intel's expert in the prior case against WARF; is that right?

A I wouldn't --

Q In WARF's prior case against Intel I should say.

A Yes.
Q What was accused of infringing? What was the name of the feature that was accused of infringing in that case?
A It was called the memory disambiguation feature.
Q And could you just briefly explain what the memory disambiguation feature is?
A The memory disambiguation --
MR. SHEASBY: Objection. Scope.
THE COURT: Is this a reference to a specific paragraph?
MR. DOWD: It's in 361, Your Honor.
THE COURT: Why don't we have a sidebar. I apologize. Actually this is probably a reasonable place to take our morning break, so we will do that and at quarter to 11 we will reconvene at that time for more testimony.
All rise, please. You probably didn't hear any of that. I will see you at ten to 11.
(Jury excused from courtroom at 10:30 a.m.)
THE COURT: Let me hear your objection, Mr. Sheasby.
MR. SHEASBY: So all he speaks about is that there's something called memory disambiguation in that section of the report. There's no description of memory

disambiguation or what it does or what it is in his report.

THE COURT: All right. And I'll hear -- the jury has already heard about memory disambiguation, so I don't know that it's really necessary for you to go into it. But is there some description as to what he understood it to be?

MR. DOWD: Yes. Two things, Your Honor. First is I think Your Honor is right and all I'm asking him to do is identify it so that we can talk about it. I'm not asking to give a detailed technical explanation.

THE COURT: The jury has heard about it and they have a general understanding of what memory disambiguation in the Intel product is. So --

MR. DOWD: He does, and --

THE COURT: I'm not going to have him do it for that purpose.

MR. DOWD: Dr. Conte -- I'm sorry -- Dr. August. I've done it again. Dr. August at paragraph 362 does specifically say I'm familiar with Intel's accused memory disambiguation feature. I've reviewed the Intel description of that feature in its technical documents. I've reviewed -- and he lists the documents and he provides a brief explanation of what it is. In Intel's technical documentation, he describes

the Sandy Bridge and Haswell processors as using memory disambiguation involving a predictor to allow load and -- to allow load to pass unknown stores --

THE COURT: Well, let's cut it short. He can describe his understanding based on that portion of his report.

MR. DOWD: That's all he's doing.

THE COURT: It needs to be consistent with it, just for framing.

MR. DOWD: And that's all it will be.

THE COURT: Anything else, Mr. Sheasby?

MR. SHEASBY: No, that's it as long as that's --

THE COURT: All right. Thank you. We will then hear I guess from -- well, I should start with plaintiff WARF. Is there anything more you wish to raise?

MR. CHU: No.

THE COURT: All right. I do have a number of exhibits to address. Was it 1656 or a different exhibit? You can advise me of that after the break. I believe you intended to move admission of 1656, which had been admitted last night. That's fine. I just need to know.

MR. LEE: I'll check.

THE COURT: In fact, let's leave it at this: It's admitted. If you intended to move a different exhibit, you can advise me after the break.

As to 1630, 1631, Mr. Sheasby, I assume there is no further issue, but I wanted to at least give you an opportunity, since I wasn't sure if they were part of this Papworth declaration.

MR. SHEASBY: So I believe that we still did maintain our --

THE COURT: You had no objections to 1630 or 1631?

MR. SHEASBY: That's right. It was the last one.

THE COURT: So let's admit those. They are admitted. And the other exhibits were 721 through 77 -- I think you were saying 721 through 775; is that correct?

MR. DOWD: It's a more limited set. It's actually 721 through 725.

THE COURT: 725, all right.

MR. DOWD: And those are the documents that are attached to --

THE COURT: Yes, I understand. They're the Papworth materials. And your objection, Mr. Sheasby, if any, is what?

MR. SHEASBY: So Alan, I think you were going to address this.

THE COURT: It's this packet you were providing. Let's do this: We'll reconvene at quarter to and I'll hear from the parties on those exhibits then. Was there something more you wanted to raise?

MR. LEE: Nothing, Your Honor.

THE COURT: Okay. Very good. I would encourage counsel to coordinate to see if you can reach an understanding as to what's being proposed, and if there is any objection, that you narrow the scope to what the objection really is between you. Thank you. We are off the record.

(Recess 10:34-10:51 a.m.)

THE COURT: Is there still an issue with respect to the exhibits?

MR. DOWD: Your Honor, I believe there is.

THE COURT: Can you describe it for me?

MR. DOWD: Yes. Yes, Your Honor.

THE COURT: Actually why don't I hear the objection from WARF.

MR. HEINRICH: Sure. So this concerns several Intel documents that were never authenticated that are in some cases drafts. Apple deposed Mr. Papworth --

THE COURT: Is this for all of them, 721

through 725?

MR. HEINRICH: Correct. If I can bring up 723 as an example. So again, Mr. Papworth was deposed. Apple didn't ask him about these documents. This is an example of one. It's a Revision 1.0 of Sandy Bridge. If we can go to page four.

THE COURT: I'm on page four.

MR. HEINRICH: Okay. So it's clearly a draft where it says crude road map. Not a real road map. I've taken many liberties. And --

THE COURT: Let me ask a question of Apple's counsel. Mr. Dowd, was there something that you -- was he asked about this document during his deposition?

MR. DOWD: He could not have been, Your Honor, because it was produced after his deposition.

THE COURT: All right. So the objection is foundation?

MR. HEINRICH: Right. And hearsay.

THE COURT: And I don't know how to rule on that. Why don't you think about your argument in terms of how I determine its admissibility without testimony as to the source. I understand it was produced by Intel. I'm just not sure about what it is I would be admitting into evidence.

Do you intend to argue with respect to these or as

to these in closing?

MR. DOWD: I believe so, Your Honor. If I could --

THE COURT: Let me --

MR. DOWD: If I could address Your Honor's point.

THE COURT: Very briefly.

MR. DOWD: Your Honor, under Rule of Evidence 902.11, if we go to the first page of this document that we have up, 723, the document is self-authenticating if it is accompanied by a certification of a qualified person that identifies it as a --

THE COURT: I see you have a declaration here. I'm not going to hold the jury up on this. We are going to continue with the trial. I'll take this under advisement. I understand the citation to the rule of evidence and you'll get one more chance to talk about this over the lunch hour.

MR. DOWD: May I ask one final question, Your Honor?

THE COURT: Yes.

MR. DOWD: And that is I do plan to ask Dr. August about these documents. May I do so under Rule 703?

THE COURT: You may do so, period.

MR. DOWD: Thank you.

THE COURT: They are legitimate use for cross. I'm just not going to admit them into evidence at this point.

MR. DOWD: Thank you, Your Honor.

THE COURT: Was there something more for Apple?

MR. LEE: Yes, Your Honor. I had neglected to give you the right exhibit number.

THE COURT: That's fine.

MR. LEE: So it's DX 1226.

THE COURT: All right. Without objection, DX 1226 will be admitted. All should rise for the jury.

(Jury enter courtroom at 10:55 a.m.)

THE CLERK: Please be seated and come to order.

THE COURT: My apologies for that delay. As you have seen throughout the trial despite the best efforts of the parties and the Court, there continues to be some disputes as to certain evidence and discovery and exhibits and that was the reason for the delay. But we're back on the record.

And you may proceed, Counsel.

MR. DOWD: Thank you, Your Honor.

BY MR. DOWD:

Q Now, Dr. August, before the break we were talking about the performance testing. Do you recall that?

A I do.
Q I want to touch on that briefly.
MR. DOWD: If we could bring up Dr. Conte's damages Slide 34, please.
Q Now, we've seen over the course of the case email from Apple engineers where the Apple engineers look at things like Dhrystone and SPEC. We had this example?
A Yes, we do.
Q Is that surprising?
A Not at all.
Q Why not?
A Well, there's a big difference between designing a processor for a product that you don't yet have and measuring the product after you have it. When you don't even have the product, you're going to use certain benchmarks out of convenience and necessity that you're not going to -- that you wouldn't -- I don't think are appropriate after you have the device. They're not able to run real applications with users or a robot interacting with the simulator. That's just not possible. So they're going to use these kinds of programs.
In addition, they're particularly interested in the worst case scenario, so they're going to use things like SPECint and you'll see Dhrystone because they want to

make sure that the worst case scenario is not unacceptable. But worst case scenario predesign, that's very different from how does the device feel to the user.

Q And so is there a difference between looking for the worst case scenario before you know what the design is going to be in trying to understand what a fair impact is in terms of the final design?

A Yeah, I hope I made that point.

Q I just note on this slide we have (d) as LINPACK. With respect to the types of benchmarks that you performed, LINPACK and Benchmark X and the other ones, in the thousands of tests that Dr. Williams described did they use these other tests?

A No. And you'll see in these tests there's some of the server benchmarks, the SPECint, and you'll also see some of the user app benchmarks, the Geekbench and the LINPACK.

Q Okay. So let's turn to -- we can take that down and let's turn to the Intel memory disambiguation point. What -- just briefly, what is the memory disambiguation component?

A This is in the Intel processor. It's a component that controls the ordering of loads and stores.

Q And that was the component that was accused in the

WARF v. Intel case?
A That's correct.
Q Do the Intel products today continue to use memory disambiguation?
A They do.
Q And have you examined that feature of -- that feature as a part of the Intel case to begin?
A Yes.
Q So that was a poorly worded question. Is that something you examined during the Intel case?
A Yeah. I did -- also looked at the RTL for the Intel products to look for that case.
Q And have you examined Intel's documentation since 2009 in this case?
A Yeah. In connection with this case I have.
Q And have you considered the testimony of Intel's engineer, David Papworth, who we saw in the video just a moment ago?
A Yes.
Q And what did Mr. Papworth testify about whether Intel continues to use memory disambiguation?
A He says they continue to use it.
Q If you could turn in your binder to tab 7. You should have DX 723 there. Do you have that?
A Yes.

Q Do you recognize it?
A This is the Sandy Bridge microarchitectural overview.
Q What is Sandy Bridge?
A This is an Intel processor, a product that they make.
Q What's the date on this microarchitectural -- microarchitecture document?
A July 2009.
Q Did you consider DX 723 in forming your opinions in the case?
A Yes, I did.
Q Could you turn to page 88.
A Okay.
Q What appears on page 88?
A So this is a slide describing memory disambiguation in this processor.
Q And what does this say about whether the Intel Sandy Bridge processor uses memory disambiguation?
A It says that it uses it and it gives some detail about how it uses it.
Q Let's go to another Intel internal document, DX -- actually before we do, can you tell us whether each page of DX 723 is stamped as Intel highly confidential material?

A Every page I've seen so far says highly confidential.
Q So this is --
A It also says *Intel top secret*.
Q So this is Intel's internal top secret explanation of how its Sandy Bridge processor works?
A Yes.
Q Okay. Now, let's go to another one. Let's go to DX 725, which would be at tab 8 in your binder.
A Okay. I'm there.
Q And what is this document?
A This is the Haswell microarchitectural overview, so this is describing a later processor.
Q What is the Haswell processor?
A It's a processor product that Intel makes.
Q What's the date on this document?
A September 2011.
Q So this is now talking about a processor after the settlement of the Intel lawsuit in 2009?
A That's correct.
Q And again, is this an internal document? Is it marked Intel top secret?
A Yeah, it's marked the same way. It says highly confidential in the bottom left and then at the bottom it says *Intel top secret*.

Q And did you consider DX 725 in forming your opinion that Intel continues to use memory disambiguation?
A I did.
Q Now, if you could turn, please, to page 87. What's shown on page 87?
MR. SHEASBY: Your Honor, I'll just preserve my hearsay objection.
THE COURT: There isn't an objection to hearsay. An expert witness is looking at documents and he can opine from those documents.
MR. SHEASBY: Thank you.
THE COURT: So it's overruled. And you may proceed, Counsel.
MR. DOWD: Thank you, Your Honor.
THE WITNESS: This slide describes the memory disambiguation feature in that processor.
BY MR. DOWD:
Q How does the memory disambiguation feature in Haswell, the 2011 processor, compare to the Sandy Bridge that we saw earlier?
A Well, the description looks identical. I haven't done a word-to-word comparison, but the concepts are all the same.
Q And so what does this say about whether Intel's Haswell processors continue to use memory

disambiguation?
A I think it's clear that's what this document is saying.
Q Let's go to Dr. Conte's Slide 104. Now, were you here when Dr. Conte presented this slide?
A I was.
Q And Dr. Conte is talking about the Haswell product?
A Yes.
Q That's the same Haswell we were just looking at?
A That's right.
Q The Haswell that has memory disambiguation?
A That's correct.
Q And do you agree with Dr. Conte -- withdrawn. Do you agree with Dr. Conte that Haswell has essentially the same performance as A7 and A8?
A No.
MR. SHEASBY: Objection. Scope.
THE COURT: Was this something that he had addressed in his report?
MR. DOWD: It was, Your Honor.
THE COURT: And the paragraph number?
MR. DOWD: It's at paragraph 377, I believe, he addresses the Haswell -- I'm sorry, 362.
THE COURT: Mr. Sheasby, do you maintain the objection?

MR. SHEASBY: Damages report paragraph 362?

MR. DOWD: Yes. Page 191.

MR. SHEASBY: As to this question I do, Your Honor.

THE COURT: The question is whether he agrees with Dr. Conte that Haswell has essentially the same performance as the A7?

MR. SHEASBY: Yes.

THE COURT: I would really like to avoid these continued delays, but we will have a sidebar.

MR. DOWD: I'll rephrase and see if I can avoid this.

BY MR. DOWD:

Q Dr. August, with respect to the Haswell, can you explain the Haswell and whether it has -- what its performance is about? That's a terrible question.

Can you explain the Haswell performance criteria?

A I don't understand the question.

Q Sure. Where is Haswell used?

A Okay. So Haswell is used in desktops and servers. It's the -- the context is very high performance. These chips are clocked at a much higher frequency. The memory bandwidth is much higher. Actually I talked about this earlier. Its data can go in and out of the chip much faster. Lots more loads and stores per

second. It's really a very high performance product that's sold individually as a processor.

Q Where is the A7 used?

A In the iPhone. iPad.

Q Does the A7 have those same characteristics?

A No. So the focus is different. You've got a battery. You're dealing with a different set of applications. You're not dealing with server benchmarks as representative of the kind of things you do on the phone.

Q Let's go to Dr. Conte's Slide 107. Now, Dr. Conte has suggested that Intel received less performance benefit from the '752 than Apple. Do you agree with him?

A I don't.

Q Is this slide comparing like with like?

A No.

Q Why not?

A Well, he's not using my number for both Intel and Apple. He's using my number for Intel -- well, actually one of my numbers, and he's using -- he's using the Geekbench score, the result of Dr. Reinman's test for one benchmark as the Apple score.

Q So he's -- if I've got it right, he's comparing Intel's number to WARF's number, not WARF's number to

WARF's number.
A Well, I'd say it's one number in my report in the Intel case to one number from Dr. Reinman's report in this case.
Q Let's look at what WARF's expert actually said in the Intel case.
THE COURT: Before you do, I want to make sure. The .8 percent that you found in Intel, what were you using to arrive at that as a performance benchmark?
THE WITNESS: So that was -- I was using internal Intel data. I was able to find some information about testing that they had done. The .8 was a result of taking the geometric mean of a set of numbers that had been identified by their expert, Dr. Stone.
THE COURT: All right. I'm going to leave geometric mean alone. Ask your next question.
BY MR. DOWD:
Q Just to follow up on that, what was the range that produced the geometric mean?
A Well, I had to exclude -- so there was -- there were some negatives -- geometric mean doesn't work with slow down, but there was a range of about .3 to 1.75, if my memory is correct.
Q So this number actually represents a range from .3

up to .175 -- 1.75?
A We have the individual numbers so we can actually look at the components of this .8.
Q Let's turn to DX 1711. It's at tab 9 in your binder. It should be in your binder at tab 9. Do you recognize this?
A This is the expert report of Dr. Christianson.
Q And was that WARF's expert in the Intel case?
A Yes.
Q What's the date on this document?
A Looks like he signed it June 19, 2009.
Q Is this a document you considered in this case?
A Yes.
Q I'd like to take you to page 51 of the report. Do you have that?
A Yes.
Q And paragraph 75 in particular. Do you see that near the top?
A Paragraph 75.
Q I'm sorry, page 51. And paragraph 75 is actually near the bottom.
A That's right.
Q What did WARF's expert in the Intel case cite as the percentage performance improvement Intel received from memory disambiguation?

A So he's saying here, and he's quoting others, that Intel had seen as much as 20 to 25 percent improvement in machine performance from this feature, and in brackets memory disambiguation alone.
Q So in the Intel -- in the WARF/Intel case, WARF's expert said Intel received 20 to 25 percent performance improvement?
A Yeah. That's what he's saying here.
Q And while we're on this page, do you see at the top of the page just above paragraph 74 WARF's expert is discussing your performance numbers in that case?
A I'm sorry, where was that?
Q It's actually -- it's at the end of paragraph 73, right at the top of 51.
A I see that.
Q Do you see how paragraph 73 carries over to the top of page 51?
A Yes.
Q And what is the range that Dr. Christianson attributes to you in terms of Intel's performance?
A So he says, reading my report, responding to my report, that I saw a range of .38 to 1.8 percent depending on the benchmark.
Q And that's what then produced this geometric mean?
A Yeah. So those were the components, and the

geometric mean came as -- like an averaging of that.
Q So let's go and compare like with like. Let's compare what WARF was saying in Intel to what WARF is saying now; what you were saying in Intel to what you are saying now.
MR. DOWD: So if we can bring up DX 1134, please.
Q What are you showing here?
A So this is just to do a fair comparison between the two cases. I'm showing some performance ranges, in the case where ranges were used, to estimate the performance of again, this is predictor versus no predictor.
Q And in the Intel case what was WARF's performance estimate of predictor versus no predictor?
A That's this number here.
Q So the 20 to 25? How does that compare with their performance -- with Dr. Conte's performance opinion in this case?
A Well, they're relying on Geekbench, so it's 8.55 percent.
Q So Intel, according to WARF's numbers, received something like more than double the benefit?
A Looks like up to more than double.
Q Okay. Now, let's focus to the bottom row. In the Intel case your range was what?

A So in the Intel case .39 to 1.75.
Q And in this case with respect to the A7, both you and Mr. Williams have arrived at what range?
A Actually Mr. Williams says 2 to 3 percent. I'm saying that based on my testing, I'm seeing 1 to 3 percent, and so that's consistent. The ranges overlap.
Q So in your opinion, is the range that Apple is in about the same as the range that -- at least overlapping with the range that Intel was in?
A Yes. It's at least overlapping.
Q Okay. So, now, let's turn to the question of whether there's a reason the '752 patent would be more valuable to Intel than to Apple. Is there a reason that the '752 patent would be more valuable to Intel?
A I believe that Intel sells microprocessors and they have to compete against others that are selling microprocessors. And microprocessors are evaluated in large part based on their performance. Apple doesn't sell processors, it sells devices like iPhones and iPads. So it doesn't -- really doesn't matter where Apple gets the performance, whether it's in software or in the processor. What really matters is what the user experiences when using that device. So Apple has more flexibility when it comes to getting that experience.
Q And if we go to DDX 11-35 --

MR. DOWD: So if we could advance to the next slide.

Q What are you showing here?

A So this is showing the product that Intel sells is the chip itself. You can buy these and you can plug them in yourself into a server or desktop, and if you want to replace it, you can do that. That's their end product. They're not -- they're not selling the servers. They're not selling the desktops. They're not selling the device that -- the computers that you would interact with personally or indirectly in the data center. Apple, on the other hand, is selling the devices.

Q Okay. And you said that's why it's more important for Intel?

A That's correct.

Q Now, let's turn to the question of power and power testing. If you could go to DDX 11-38, please. You're familiar with the opinions that Dr. Annavaram has provided in the case?

A I am.

Q And do you agree that the LSD predictor would produce one-and-a-half to two hours of extra battery life?

A No.

Q Let's turn in your binder to tab 11. You should have PX 646-R, which I believe has been admitted.

MR. DOWD: If we could bring that up. And turn to the next page, please.

Q So we have PX 646-R on the screen. It's a bit hard to read. It's in your document. What is this presenting?

A So these are the results that Dr. Annavaram has measured and then from those measurements he's applied a series of equations to compute other numbers.

Q And if we could focus on column R and blow that up for a moment. What's shown in this column?

A So this is the Mode 3, so this is without the predictor entirely. He's saying that this is the estimated battery life in hours under the min brightness. He's setting the display to minimum brightness case.

Q So is this the amount of time that it will run until the battery is just flat dead?

A Yes. So he's taken some -- a server benchmark, which has basically 100 percent duty cycle, it's really crunching on the processor, and he's estimated based on his current measurements that the battery that comes with the iPhone would actually only sustain that for about -- it looks like around two to three hours before

it dies and there's no more battery left.
Q So he did that for both Mode 0, where you have the LSD, and Mode 3 where you don't.
A Yeah. And I should point out this is not -- he didn't perform this test. This is -- he looked at when you run the program how much energy it uses, how much power it uses, and then from that he calculated when the battery would run out. And these are those calculations.
Q Okay. And so far is there any real dispute that the battery actually dies at something like between two to three hours?
A Yes. I didn't have any reason to -- well, there's -- his measurements are his measurements and there are actually some flaws with those measurements, but I don't dispute that that's the current he measured. And if you have that measurement, you can then apply an equation to figure out when the battery is going to run out based on published numbers about how much energy is stored in the battery.
Q The duty cycle on this, what is the assumption about the duty cycle that the processor -- let me start with what is a duty cycle for a processor?
A Yeah. So in the device, most of the time, almost all of the time the processor is asleep. When the phone

is in your pocket, the processor doesn't need to do anything. When the phone is waiting for you to hit the next character on a text message, there's no reason for the processor to do anything. So to save energy, the processor goes to sleep.

Over the course of 10 or 12 hours, the processor is going to be asleep most of the time. Now, what this is is because he's using the benchmarks that Dr. Conte said not to use, he's using the server benchmarks, he's using the 100 percent duty cycle. This means the processor is full blast until the end.

There's a couple issues with that. First is the phone is going to overheat. When the phone gets too hot, things are going to change. It's going to try to recover so it doesn't, you know, become defective, melt, whatever, hurt the user. But if you assume this doesn't happen, and this is when the battery would run out based on that calculation.

Q So at least up to this point, we're at the point where there's no more battery. When the battery is dead, can the processor process anything?

A No. If there -- obviously if there's no power, you can't do anything on the phone.

Q So beyond this point, you can't actually perform any processing instructions or anything like that?

A That's right.
Q What does Dr. Annavaram do next?
A Well, he went to the Apple web page and it says that when you do certain things, your iPhone will last 10 or 12 hours. And he says well, let's just assume that's right. But he doesn't take into account the duty cycle. He doesn't take into account that for most of that 10/12 hours your phone is sleeping because it wants to be ready. It wants you to have battery when you need it. Because he's not taking that into account. What he's effectively doing when he scales these numbers up to 10 or 12 hours is he's basically saying the battery is on the order of five times larger than it actually is. So I don't see any basis to do that.
Q And so can you explain what the reason for that is? Is there a reason for that that relates to his basic assumption that you've got the CPU running 100 percent flat out?
A Yeah. I think it's not -- it starts fundamentally at not using a workload that's representative of what anyone is going to do with their phone. It's a workload that just doesn't have user interaction; doesn't do anything that -- I think anyone -- well, certainly I wouldn't find useful and assumes 100 percent duty cycle. It's just hammering on the processor to exaggerate its

value.

MR. DOWD: And so if we go over to his column U and if we could blow that up.

Q What is he showing in column U?

A So this is again Mode 3 without the predictor and it says here *scaled*. So estimated battery life scaled by a factor. Now, what's interesting -- so this is basically just saying assume you have some additional number of batteries in this full duty cycle mode, how long would your battery last? That's unrealistic, and in fact, earlier in his report he says that this is an impossible scenario.

Q So is it mathematically possible to actually achieve the numbers that he presents here?

A No. The numbers he showed in the other column indicate when the battery would run out. I don't know how you scale from when the battery runs out to anything beyond that. Once the battery is dead, it's dead.

Q So to get to his numbers about one-and-a-half to two hours of extra battery life, does he have to assume a battery that's larger than it actually is?

A Yeah. Somewhere around five times larger.

Q Does he have to assume the CPU can run for eight to ten hours longer than it actually can according to his own numbers?

THE COURT: Counsel, we're going over and over the same thing. You're not just going to repeat the same testimony.

MR. DOWD: No, Your Honor. I'll rephrase. I'll rephrase.

BY MR. DOWD:

Q What does he assume about how much longer the CPU can operate beyond what his own numbers say?

THE COURT: That's also been something we've covered, Counsel.

MR. DOWD: Okay.

BY MR. DOWD:

Q If we go to -- let me ask you this: How would you characterize what the battery life differences would be if we actually applied mathematically possible calculations?

A Yes. Once you factor in the duty cycle, it's not that the time in that first column, the additional battery life goes up, it actually goes down because for that additional time, the processor is not running full speed. That additional time, the display may be on or the radio may be on, but the processor isn't. So that number actually goes down. When you pull out a lot of these assumptions that are incorrect, you actually get to what I would characterize an insignificant difference

in the battery life, less than a minute over the course of ten hours.

Q And so in terms of the actual difference that the LSD makes, LSD versus no LSD, how long?

A I think once you get to less than a minute over ten hours, I don't want to do the calculation because there are other factors like how warm the phone is, whether other people are using a phone around you and interfering with your communication, that will have a bigger impact. So I think it's irresponsible to do a calculation like that.

MR. DOWD: If we can go to DDX 11-38 and advance the slide. One more.

Q What are you showing here?

A This is just basically the assumption that there's more battery than there actually is.

Q Okay.

MR. DOWD: Now we can take that down.

Q Let's turn to the question of alternatives. Dr. August, all of the testing that anyone has done in this case has involved just turning the LSD predictor off; is that right?

A That's correct.

Q What was the alternative -- sorry, withdrawn. Let's go to slide DDX 11-39. Were there alternatives

between the extremes of having an LSD and nothing?
A Yes. I believe that if you couldn't use the LSD, you would look for alternatives and I've identified a few.
Q And so was having the A6 LSD predictor, was that an alternative?
A Yes. They could have taken the A6 LSD and scaled it or made changes appropriately to make it work in the A7.
Q What about the load-store predictor from Hesson?
A Well, that's prior art, so they could have done that as well.
Q And EV 6, was that available as well?
A Yes.
Q Let's turn to the question of Samsung. Do you recall there was testimony about Samsung?
A Yes.
Q Have you formed an opinion about whether Samsung makes anything in the United States that could infringe the '752?
A I do have an opinion.
Q What's your opinion?
A They do not.
Q If we go to DDX 11-37, what are you showing here?
A So on the left, this is the wafer with die. Each

one of these rectangles is a representation or actually what the die would look like if you saw one of these wafers after it had been processed.

MR. DOWD: May I approach, Your Honor?

THE COURT: You may.

BY MR. DOWD:

Q Doctor, if I can give you an actual wafer, can you explain this process? So how does that wafer that we've just handed up relate to the image that you show on the slide?

A So this is the wafer before the photolithography. They basically use a series of steps with chemicals and a mask that provides a shadow that indicates where the wires and transistors should go on this wafer. And then it will look more like what we see in the picture.

Q Now, what manufacturing takes place at Samsung in Texas?

A They perform that step in Texas.

Q And is that just the initial fabrication step?

A Yeah. There are many other steps before this becomes product.

Q Now, let me contrast the wafer that you have there with -- if we can go to the ELMO -- the A7 chip. What does it take to go from the wafer, if you can hold up that wafer, to this little chip?

A Well, so there are a number of steps because that chip is in a package. So in general or in this case? I could describe either way. It doesn't matter.

Q Why don't we describe the process generally.

A Okay. Sure. So there are many steps, but the ones that are most important for this case are after the photolithography, there's also a step called bumping and this is where additional -- really look like little balls of metal are placed down so that electricity either signals or power can actually get into the chip. So that's bumping.

In addition, there's fusing and that's blowing -- there may be hundreds or thousands of fuses on a chip. You blow some fuses and that actually will configure the circuitry into its final form. In addition to fusing, they also want to slice this up. This is a chip, a single die on the wafer. There may be 100. So you have to cut it very carefully and pull those pieces out. And there are a series of other steps to put it into the package: More wiring protection, that kind of thing.

Q So if we go back to your slide, is it that each one of these individual squares on the wafer ultimately ends up having to be sliced and all these other processing steps?

A Some are thrown away if they're defective, but the

ones that are okay will end up in a package like you saw on the ELMO.

Q So let's focus on some of the key aspects that you identified. Once the circuitry is printed on the wafer, what happens next in the Samsung process?

A Then it's sent to Korea.

Q The whole wafer is sent?

A Yeah, just like this.

Q Okay. And at that point do we have any chips yet?

A No, we have no chips.

Q Could the wafer be used in an iPhone?

A No.

Q Could any of the circuitry on the wafer be used to process an instruction?

MR. SHEASBY: Objection. This is a scope issue.

THE COURT: And the paragraph in which he testifies as to whether it could be used in a product is what?

MR. DOWD: One moment, Your Honor. This is actually in the infringement report, if I could just grab that. I believe it's at paragraph 412, but I just want to confirm.

THE COURT: In the meantime, Mr. Sheasby, perhaps you can look. Please, if you have that report

in front of you.

MR. SHEASBY: It's paragraph 413.

THE COURT: And do you maintain your objection?

MR. SHEASBY: I do and I -- I do.

(Discussion at sidebar at 11:32 a.m.)

THE COURT: Do you have 413 with you? Just bring it up. Mr. Sheasby, I'll take that. And your specific concern is with respect to its ability to actually perform the functions?

MR. SHEASBY: Yes. This is the test probe issue that came up yesterday and he doesn't talk about test probes or the impact of test probes.

THE COURT: It's not really a test probe issue. He's asking whether it could be used to perform the functions. And you're saying that he nowhere opined that it could not?

MR. SHEASBY: Correct.

THE COURT: I'm going to allow him to testify. I mean he says it's not a processor capable of executing program instructions. If you want to draw out that distinction --

MR. SHEASBY: I understand.

THE COURT: -- and the fact that he never opined, never examined it, you can do that. Let's proceed.

MR. SHEASBY: Thank you.

(End of sidebar discussion at 11:33 a.m.)

THE COURT: All right. We will proceed.

BY MR. DOWD:

Q So Doctor, can you answer that question?

A Can you repeat the question?

Q Sure. At the point at which the wafer leaves the manufacturing facility at Samsung in Texas, can any of the circuitry actually process instructions?

A No, they cannot.

Q Why not?

A Well, the circuitry is actually not complete until it's been fused, and the fusing does not happen in Texas.

Q Where does the fusing happen?

A In Korea.

Q Now, you mentioned bumping. Is bumping related?

A Yes. Bumping is also done in Korea.

Q And how does bumping impact the ability of the chip to be able to actually process instructions?

A So the bumping will allow the chip to be powered and you can connect to it memory and other things so that it can communicate with the outside world. At that point after fusing and bumping, it would be capable of executing instructions.

Q So that's only after you get to Korea?
A That's correct.
Q All right. So as the circuitry on the wafer leaves the United States, could you load a program onto any of the die at all?
A No.
Q Could you cause it to -- is it capable of executing any program instructions at all?
A No.
Q And with respect to the fuses you mentioned, what is the importance of blowing the fuses?
A Well, there are actually components in the microprocessor, in the die that aren't fully configured. There are some measurements that need to be taken to figure out, for example, how to interact with cache memory. And once those measurements are taken, the fuses can be customized and blown for that particular die and at that point will actually be able to communicate with memory. So that actually activates part of the circuitry or completes some of the circuitry. Before that's done, there's no -- it's not functional.

MR. SHEASBY: Your Honor, I move to strike that. That's outside the scope of his report.

MR. DOWD: Your Honor, it's page 163 just above

paragraph 412.

THE COURT: I will give an instruction -- let's do this. We've got to come to sidebar. And I apologize because we should not be having this many delays.

(Discussion at sidebar at 11:35 a.m.)

THE COURT: The specific reference is?

MR. DOWD: That was the question. Blowing fuses. What does it do. It allows the software to work.

THE COURT: I'm looking at the statement Samsung configures the chips to the extent that the chip is able to work with implementing Apple software.

MR. SHEASBY: Right. He can say that. They're making a new argument for the first time this morning with Mr. Williams that the circuits will not work without blowing the fuses. It's never been disclosed to us and that's what he's trying to talk about right now. He can say --

THE COURT: I'm more concerned -- he does say so the chip is able to work. The implication is the same. My concern is are they saying that there's a separate process -- well, I mean the blowing doesn't occur until -- I'm not going to strike it. Continue.

(End of sidebar discussion at 11:36 a.m.)

THE COURT: You should ask your next question,

Counsel.

MR. DOWD: Thank you, Your Honor.

BY MR. DOWD:

Q With respect to blowing the fuses, is the chip able to work with software before the fuses are blown?

A No.

Q Is that true for all processes?

THE COURT: I don't understand that.

THE WITNESS: I don't either.

BY MR. DOWD:

Q Before the fuses are blown, can you load a program onto the die on the wafer?

A Can you repeat the question?

Q Before the fuses are blown, can you load a program, a computer program, a set of instructions onto the die on the wafer?

A No, you can't.

Q Can you do that in any testing?

A No.

Q And where does testing happen? Is that in the U.S. or Korea?

A That happens in Korea.

Q Okay. Now, Dr. Conte testified that a processor is complete as soon as it is printed on the silicon wafer and that later steps in the manufacturing process have

no impact on the functionality of the processor. Do you agree with him?

A I disagree.

Q Why do you disagree?

A Those steps are necessary steps to make the processor work.

Q Let's go back to PX 1, the '752 patent.

MR. DOWD: If we could bring that up and turn to claim 1.

Q And I'd like to focus you on the portion of the claim at the top, the limitation that reads "a processor capable of executing program instructions in an execution order differing from their program order."

Can the wafers that leave Samsung's facility in Texas perform that function?

A No, they can't.

Q Why not?

A Because they're not capable of executing program instructions in any order.

Q And what are your reasons for that?

A Because they haven't been fused. They haven't been bumped. They are not complete.

Q And what does that mean for whether those wafers are capable of practicing claim 1?

A They are incapable of practicing that claim.

Q Does claim 9 have the same requirement?
A Yes.
Q And are your opinions the same for claim 9?
A Yes. (11:39 a.m.)

MR. DOWD: Your Honor, I pass the witness.

THE COURT: Good. Cross-examination.

CROSS-EXAMINATION

BY MR. SHEASBY:

Q Good morning, Dr. August.
A Good morning.
Q We've met before a couple times. I want to turn first to the Intel case, if I may. Now, in the Intel case you served as an expert for Intel; is that correct?
A That is correct.
Q You took the position that the Intel feature was noninfringing; correct?
A That's correct.
Q And as part of your work for them, you were asked by Intel to calculate the average performance gain or loss attributable to memory disambiguation across all three platforms: Mobile, desk, and servers based on Intel's 2006 benchmark testing; correct?
A Well, I was asked more generally to comment on the performance.
Q Well, you were asked, and I'll read it again, you

were asked to calculate the average performance gain or loss attributable to memory disambiguation across all on three platforms: mobile, desktop, and server based on Intel's 2006 benchmark testing; correct?

A Can you repeat the last part of that question?

Q You were asked to calculate the average performance gain or loss attributable to memory disambiguation based on Intel's 2006 benchmark testing.

A That's correct.

Q And when you combined all those -- actually let me ask you the next question. Now, for this benchmark testing, the way it worked is that when you disabled memory disambiguation, which was the Intel feature, then the processor would not speculate; correct?

A When you disabled the memory disambiguation feature, the processor would not speculate with respect to loads and stores.

Q Exactly. So the disabled mode was no speculation with respect to loads and stores.

A That's correct.

Q And the enabled mode was speculation some of the times with loads and stores; correct?

A Some of the time, yes.

Q And when you did the calculation, when you took every single benchmark that Intel had run in 2006 and

you applied that geometric mean, which is a fancy word for some type of average, it was 0.80 percent; correct?

A Well, I don't know if I had every benchmark that Intel had in 2006, but all the ones that I was aware of, yes.

Q At least all the benchmarks that Intel gave you, you combined them all together and concluded that memory disambiguation contributed 0.80 percent benefit; correct?

A That's with the geo mean, yes.

Q And we can actually show that slide, we'll show those numbers.

MR. SHEASBY: Mr. Oppenhuis, I believe it's 21.

Q So I have those numbers. That's correct; is that right?

A That looks correct.

Q Okay. Now, in the Apple LSD predictor, there are different modes that you can switch it too; correct?

A That's correct.

Q And one of those modes is a no speculation of ambiguous load-stores; correct?

A That's correct.

Q That's Mode 2; correct?

A That's correct.

Q And now let's pull up August cross demonstrative 9.

THE COURT: Since we're on it and since it's come up and been characterized, is the difference between a mean and a geometric mean and what's the difference?

THE WITNESS: So a mean is the average like we're all familiar with. You sum the numbers up, you divide by the number of numbers. Geometric mean involves multiplying the numbers together and taking a root.

THE COURT: And the benefit of the geometric mean is what?

THE WITNESS: There's some debate in the community about which one is more true to the original numbers when talking about rates, which we're doing here.

THE COURT: All right. And is there a dramatic difference between the mean and the geometric mean in a case like this?

THE WITNESS: There can be.

THE COURT: Are you aware whether there is in this case?

THE WITNESS: Well, in this particular slide there is because of the way that geometric mean has a problem with negative numbers, so the mean here will be different than --

THE COURT: It does when you multiply them, you end up with a positive, which you don't want.

THE WITNESS: Well, you end up with a negative and you have to take the root of the negative.

THE COURT: All right. You can continue.

BY MR. SHEASBY:

Q It's actually a relevant point. You took the geometric mean of this, and you see the WME 9 number was a negative 6.15 percent number?

A That's correct.

Q If you just took the average where you could actually integrate that negative number into the mean, it would be something closer to 0.3 percent thereabouts, in that neighborhood?

A Well, I think it would be lower than the .8.

Q It would be lower than the .8. Would you take my representation that you said it would be in the .3 range in your Intel damages case?

A I don't have any reason to believe that you're making that up.

Q I wouldn't do that. I promise.

A Thank you.

Q So here's what we know: We know that at Intel, when you took all the benchmarks that Intel gave you in 2006, it was 0.8. We know that modes that you switch

between was between memory disambiguation and no speculation of ambiguous loads and stores; correct?

A That's correct.

Q And now we can actually think about that in the context of Apple's processor. In Apple's processor, we can add the LSD predictor on; correct? That's one option. That's Mode 0.

A Yes.

Q And then another option is we can switch to a mode where no speculation of ambiguous loads and stores is allowed; correct?

A We could do that.

Q And that's called Mode 2; correct?

A That's right.

MR. SHEASBY: Why don't we go to August cross demonstrative 9, Mr. Oppenhuis.

Q So we actually have Mode 2 numbers that were run by Dr. Reinman; correct?

A Yes, I've seen them.

Q Now, you didn't run Mode 2, did you?

A No, I didn't.

Q And the Mode 2 differences for between LSD on and no speculation in the A6 -- A7 and A8, it's not .08 percent, is it?

A No.

Q It's 114 percent on Dhrystone; correct?
A Yeah. If this is correct, yes.
Q It's 53.78 percent on SPEC; correct?
A For the seven, yes.
Q And Mr. Srouji, remember, he's the senior operating engineer, he said that SPEC was industry standard; correct?
A It's industry standard for some things, yes.
Q And then on Geekbench, the Geekbench score was 59.64 percent; correct?
A I believe that that sounds about right.
Q And it's that Geekbench that we've seen internal Apple documents talking about being "not open to debate"; correct?
A I think those are words that some people have used, yeah.
Q At Apple. Some people at Apple have used.
A One person.
Q And you disagree with that; correct?
A Well, I think that Geekbench serves a purpose.
Q Can you answer my question? Do you disagree with the statement that Geekbench is not open to debate?
A Well, it depends on how it's used. You can debate whether it's appropriate in different circumstances.
Q Sir, can you answer my question yes or no fairly?

Do you disagree with the statement that in the context of Apple's A7 and A8 processors, Geekbench is not open to debate?

A There's some assumptions in that question I'm not sure how to answer.

Q Okay. That's no problem. Now, you read some testimony from Mr. Christianson; correct? I'll take it back. You paraphrased a report filed by Mr. Christianson in the Intel case; correct?

A On my direct? Yes.

THE COURT: And for the benefit of the jury, there are two Mr. Christiansons. You saw one by video. Not the same. This is now a damage expert in the Intel case. And you may proceed.

BY MR. SHEASBY:

Q And Mr. Christianson was not a technical expert for WARF in that case; correct?

A That's my understanding.

Q The technical expert for WARF in that case was Mr. Stone; correct?

A There were many technical experts for WARF.

Q The technical expert who on infringement and performance issues was Mr. Stone; correct?

A Primarily, yes.

Q And Mr. Stone filed a report in that case as well;

correct?
A Yes, he did.
Q And I think Mr. Stone's report should be up there. Is it up there? It should be in the front pocket of your big binder.
A This one?
MR. SHEASBY: May I approach to assist, Your Honor?
THE WITNESS: This?
THE COURT: It should be right there. There's one that's damage report of Stone and then rebuttal expert report of August.
BY MR. SHEASBY:
Q It's the damages report of Stone. You have it.
A Here we go.
Q And why don't we go to the end of Mr. Stone's report, which is paragraph 41.
THE COURT: Was there a question?
Q Are you oriented, sir?
A Yes.
Q And in paragraph 41, Mr. Stone also calculated his position on what the performance benefit of memory disambiguation was; correct?
A I think he's using my numbers to compute an average instead of a geo mean.

Q What he says is he provides his own calculation of the Intel information that was given to you; correct?
A Yes. He's doing a calculation using a different mean with my numbers.
Q Right. So he took the Intel numbers from 2006 and he ran his own calculation; correct?
A That's correct.
Q And his conclusion was that the average benefit of memory disambiguation was 1.89 percent; correct?
A That's correct.
MR. SHEASBY: And why don't we put up his slides, Mr. Oppenhuis. We'll put up his data to make sure we have it right.
Q Now, that's his data; correct? 1.89 percent average.
A No, he's taking my data and applying a different equation.
Q I appreciate the precision. I'll reask it again. This is the Intel data that was given to you; correct?
A Yes.
Q And he's doing a calculation of that same Intel data; correct?
A That's correct.
Q And his average is 1.89 percent; correct?
A I wouldn't characterize it as his average. It's my

data that he's averaging in a different way.

THE COURT: Is it your data or Intel's average?

THE WITNESS: Well, it was Intel's -- each of these benchmarks is going to involve many other numbers that get averaged. So it's Intel's averages that I've selected --

THE COURT: It's Intel's averages. You selected them as relevant, and this is now another expert, technical expert who did his own average from your averages.

THE WITNESS: That's correct.

THE COURT: Next question.

BY MR. SHEASBY:

Q And to be clear, 1.89 percent was his number.

A I wouldn't characterize what he's saying here as that's his number. That's his number in this scenario.

Q Can you turn to paragraph 42 of his report. And you see where he says "using this methodology, the average improvement from memory disambiguation across the six benchmarks is 1.89 percent."

A I see that.

Q Did I read that statement correctly?

A You did.

Q Okay.

MR. SHEASBY: So why don't we go back to the

slide we were on previously. Actually why don't we go to -- give me a second -- why don't we go to DDX 11-34.
Q Now, this was a slide that you showed to the Ladies and Gentlemen of the Jury; correct?
A That's correct.
Q And you stated that Mr. Christianson said that the benefit to Intel was 20 to 25 percent; correct?
A Yes. Up to 20 to 25 percent.
Q Well, there you said 20 to 25 percent, correct, on that slide?
A I think later I said -- I said up to.
Q Okay. So can you, just for the purposes of clarity, did Mr. Christianson say the benefit was 20 to 25 percent or did he say on some traces it may be up to 20 to 25 percent?
A Yes. It was one of the numbers he put forth as up to.
Q Up to; correct?
A That's correct.
Q And the basis for that was actually an article; correct?
A I believe so.
Q And that was an article that we looked at at your deposition. Do you remember it? The Anandtech article.
A I don't remember that.

Q So you don't know if that article was saying -- let me ask it this way: The 20 to 25 percent number, those relate to individual traces or pieces of code; correct?
A Can you show me the article?
Q Well, do you know what the 20 to 25 percent relates to?
A At some point I might have.
Q Do you know --
THE COURT: As you sit here today, you don't know where Dr. Christianson, who was not a technical expert but was an economist, you don't know where he got the 20 to 25 percent from as you sit here today.
THE WITNESS: As I sit here today, no, I don't recall exactly.
THE COURT: Next question.
BY MR. SHEASBY:
Q We all agree what Dr. Christianson said was up to on some benchmarks; correct?
A Yeah. He had many numbers he used and that was one.
Q But the number that Dr. Stone used was 1.85 percent; correct?
A Among others.
Q Now, in the Intel case you stated in your report that Intel is disabling the memory disambiguation

feature; correct?
A I said that in conversations I had had with Dr. Papworth, that was my understanding.
Q And you used the phrase Intel is disabling the memory disambiguation feature; correct?
A I understood that to be their plan, yes.
Q And just so we're clear, if you can answer my question yes or no for the Ladies and Gentlemen of the Jury, please do so. You said in your report "Intel is disabling the memory disambiguation feature."
A That sounds right, but I could check it for you if you'd like.
Q Sounds right; correct?
A Sound right, yes.
Q Now, sometime after that Intel turned back on the memory disambiguation feature; correct? That's your testimony?
A That's my understanding.
Q Now, you didn't analyze any of the code, the RTL code for Intel's new products; correct?
A Actually I did.
Q Oh, that's right. You analyzed the portions of the RTL code from the old products that happened to be in the new products; correct?
A No. I looked at new products.

Q In your report do you analyze any RTL code for Intel's new products?
A In my report I don't describe that analysis.
Q Okay. Now, in general it's your position that pre-silicon simulation is less accurate than post-silicon testing; correct?
A Well, I would say that there are different purposes. Pre-silicon/post-silicon testing is going to be generally done for different purposes.
Q Sir, can you answer my question yes or no?
A Can you repeat the question?
Q Pre-silicon performance simulation is less accurate than post-silicon testing; correct?
A I would say that's generally true.
Q Now, the numbers that Mr. Williams were talking about -- that Mr. Williams was talking about in his testimony, that was on pre-silicon simulation; correct?
A That's correct.
Q And what we did in this case was not the simulator at all. What we accessed, what we used, Professor Reinman and you, were the actual silicon, the physical devices.
A Yes. We did the test on actual devices.
Q cSim no one used; correct?
A None of the experts used cSim in this case.

Q Now, in your testimony on direct you speak about a number of potential design arounds; correct?
A That's correct.
Q And in your testimony on direct, you don't report any percentage of what could be achieved from using an alternative to the LSD predictor; fair?
A That's correct.
Q Now, in your Intel damages report, Intel had actually prepared in code a design around to the '752 patent; correct?
A Yes.
Q And you reported that they were able to achieve roughly 82 to 85 percent of the performance gained if they used their design around as opposed to the '752 patent; correct?
A That's right.
Q Let's turn to another subject. I want to talk about all the pieces that are in the A7 and A8 processor.
A Okay.
Q You gave this long list: Memory system, graphic system, media, NAND, secure enclave, I/O, power management. You gave this list; right?
A That's right.
Q Now, you don't have any evidence that Apple is able

to compete with folks like Samsung or other chip manufacturers based on any of those subsystems; correct?
A Well, I didn't take any performance measurements of those systems. So from that technical basis, I can't tell you about the performance of those aspects.
Q In other words, from a technical basis you have no ability to say whether those subsystems allow Apple to be unique and allow it to compete; correct?
A Well, I understand that those are very important subsystems that are necessary --
Q Sir, can you answer my question yes or no?
THE COURT: I think he was attempting to answer your question and I think you should rephrase rather than pose that one.
MR. SHEASBY: Sure. I'm happy to do so.
BY MR. SHEASBY:
Q You disagree that 75 percent of the value of the A7, A8, and A8 SoC is attributable to the processor that contains the accused functionality; correct?
A Correct.
Q You think anyone who takes that position is mistaken; correct?
A I would say in this case for this SoC, I think that overstates the benefit.
Q Now, one of the things you talk about is lines of

code that are devoted to the LSD predictor; correct?
A Yeah, I counted the lines of code.
Q And you've never designed a commercial processor; correct?
A I've been part of commercial processor design projects.
Q Oh. Okay. Your research group at Princeton has not produced a product; correct?
A That's correct.
Q And you haven't designed something that can be produced as a product in its final form; correct?
THE COURT: You're talking now about the Princeton Research Group?
Q I'm talking about you generally, Professor August.
A I'm not sure what you mean by final form. There's a lot of steps that go into producing a processor and many of them happen early and then many of them happen later stage.
Q So just so we can get the record clear, you haven't designed something that can be produced as a product in its final form; correct?
THE COURT: You have contributed to a design, but you didn't produce it, design the product in its final form.
THE WITNESS: Yeah. I think that's what

engineers do, they contribute to the project.
BY MR. SHEASBY:
Q Okay. Well, why don't we read some of your testimony. Actually, you haven't designed a commercial memory dependence predictor; correct?
A That's correct.
Q In fact, you haven't designed any functional unit in a commercial processor; correct?
A I've made contributions to functional units.
Q Sir, why don't we read your testimony at 68 --
THE COURT: Why don't you pose the question again and see if there's really a disagreement.
BY MR. SHEASBY:
Q You have not designed any functional unit in a commercial processor; correct?
A I've contributed to the design.
Q Okay. Why don't we read your testimony at 68, 12 through 16.
"Question: Have you ever designed a commercial memory dependence predictor?
"Answer: I haven't designed a dependence predictor that isn't a product."
Is that your testimony, sir?
A That's what I said.
Q Now --

MR. DOWD: I object. That's not --

THE COURT: It was improper impeachment and you should ignore the reading. And you should continue.

BY MR. SHEASBY:

Q So we were speaking again about lines of code; correct?

A Lines of code, yes.

Q In the LSD predictor.

A In the LSD predictor, yes.

Q Right. And in your report, do you identify any engineer who designs processors in a commercial context who believes lines of code is an appropriate way of valuing a feature in the microarchitecture?

A In my -- are you asking is that a true statement or is it in my report?

Q In your report do you identify.

A That I don't know.

Q And do you identify in your -- another thing you talk about is how much area on the die the LSD predictor takes up; correct?

A Yes. I do report that in my report.

Q And in your report do you identify any commercial engineer, someone who designs processors for a living, who uses the amount of real estate a feature takes up as a metric of its value?

A So you're asking about what's in the report?
Q Yes.
A I don't know sitting here without reviewing it exactly what's in the report.
Q Would you take my representation that they aren't in your report?
A Without the report in front of me, I have no basis to disagree.
Q Okay. So why don't we go to 11-11 -- wait. 11-11, let's start there. You were talking about some of Apple's patents. Do you remember that?
A Yes, I do.
Q Let me turn to my section. Now, the first thing you did -- well, not the first thing. You showed up the slides where you said 71 Apple patents; correct?
A I said at least 70.
Q At least 70. Now, you were only -- of those 70, your report only identifies six, I believe, that you could find in the A7 and A8 processor using a claim chart; correct?
A I only did the claim chart for six, I believe. Yes.
Q Okay. So we were at 71. Now we're at six. Let's talk about those six.
MR. SHEASBY: Let's pull up 11-11. Sorry,

Mr. Oppenhuis.

Q 11-11. This is the Apple '447 patent; correct?

A That's correct.

Q Now, is this patent related to anything that's physically in the LSD predictor?

A This does not describe the LSD predictor, but there's going to be interaction between the loads and stores.

Q Well, let's do it in pieces.

A Sure.

Q This patent doesn't describe the LSD predictor; correct?

A That's correct.

Q It describes some other feature that's outside of the LSD predictor; correct?

A That's correct.

Q Let's go to the next patent. Let's go to the next slide, 11-12. *Inline image rotation*. Does this patent that you showed describe anything in the LSD predictor?

A No, it does not.

Q Let's go to the next patent you showed, 11-13. Does this patent describe anything in the LSD predictor?

A No, it doesn't.

Q Let's go to the next slide, 11-14. Does this slide describe anything in the LSD predictor?

A No, it doesn't.
Q Let's go to the next slide, 11-15. Does this slide describe anything in the LSD predictor?
A No.
Q And for these patents that we've shown, I've shown you Slides 11-11 through 11-15, you've done no analysis on the performance benefit quantitatively that is achieved using these features; correct?
A No, I haven't done that analysis.
Q And you've done no quantitative analysis on the energy benefits that's achieved using these features; correct?
A Not for these features.
Q Okay. Let's go to your user interface patents. These are the patents that Apple asserted against Samsung. Let's go to 11-36. We talked about these patents. These are the patents on, for example, rubber banding; correct?
A Yeah -- yes.
Q You've heard of it as rubber banding.
A Yes.
Q And you understand that Ms. Drance, she's the head of marketing at Apple; correct?
A If you represent that to me. I have no reason to disagree.

Q If you're putting me on the spot I'm going to do it more precisely. She's the head of iPhone marketing at Apple.
A I believe that.
Q Okay. I appreciate it. And Ms. Drance has stated that rubber banding is not something customers even care about; correct?
A I don't recall one way or the other.
MR. SHEASBY: So why don't we pull up her testimony, which is at 201 through 205, and let's see what she says.
MR. DOWD: Objection. There's no foundation for this witness.
THE COURT: You may have him read it, but it's not to be shown to the jury.
MR. SHEASBY: I understand.
THE COURT: And you shouldn't read it aloud.
BY MR. SHEASBY:
Q Do you see the testimony?
A Yes.
Q And does this refresh your recollection about what Ms. Drance thinks of rubber banding?
A No. It appears that maybe she hasn't heard it by that term.
Q Ms. Drance is saying she hasn't heard the concept

of rubber banding; correct?
A She says -- can I read the question?
THE COURT: The real point is it doesn't refresh your recollection about anything she said in this area.
THE WITNESS: No.
THE COURT: Next question, Counsel.
MR. SHEASBY: We'll move on.
BY MR. SHEASBY:
Q Let's talk about energy. Professor Annavaram ran some studies regarding energy; correct?
A I wouldn't call it a study.
Q Professor Annavaram did some analysis regarding energy; correct?
A He took some measurements and applied some factors.
Q Now, you didn't run any study regarding energy; correct?
A No.
Q You didn't take any measurements; correct?
A I didn't take any measurements.
Q And there's nothing that would have prevented you from running an energy study; correct?
A No.
Q There's nothing that would have prevented you from presenting data from -- to the Ladies and Gentlemen of

the Jury that could have been used to dispute Professor Annavaram; correct?

A I did present opinions and an analysis that disputes his results.

Q I'm sorry. I said data.

A Data.

Q There's nothing that would have prevented you from performing experiments generating data and presenting them to the Ladies and Gentlemen of this Jury; correct?

A Well, I did present data. I presented Dr. Annavaram's data to refute his conclusions.

Q Sir, I will ask the question more precisely. There was nothing that would have prevented you from performing your own experiments and presenting that information to the jury on energy; correct?

A That's correct.

Q And you didn't do it; correct?

A That's correct.

Q Now, another thing you talked about is the differences between the Haswell processor and the A7 processor and the A8 processor. Do you remember that?

A Yes.

Q And the -- you said that Professor Conte's connection of the Haswell processor which sells in the $200 range to the A7 to A8, you disagreed with that;

correct?
A That's correct.
Q Why don't we go to PX 161, and let's not show it to the jury. Now, PX 161 is an Apple presentation; correct? And we can scroll down a couple pages so you can talk about it.
A It looks like some slides.
Q It's a group of slides that has an Apple Bates range on it; correct?
A Yes.
Q And it relates to the A7 processor, which is one of the things you've studied in this case; correct?
A Yes. Here is the slide. There's a slide that shows the A7.
Q And it relates to issues --
MR. SHEASBY: Why don't we scroll down one more slide.
Q It relates to key aspects of what's important in the iPhone and iPad products; correct?
A What are you saying this represents?
Q It talks about some features of the iPhone and iPad products.
A I don't agree with that.
Q Okay.
MR. SHEASBY: So why don't we go to Slide 61,

page 61 of that presentation. Now, in PX 161, we're on slide -- can we go down one more slide? Let's do that. We'll go to PX 161, page 62. And if you see this --

MR. DOWD: Your Honor --

THE COURT: Is there any objection?

MR. DOWD: It's just that this doesn't appear to be in the witness binder that I was handed.

THE COURT: I'll allow it. You can proceed.

MR. SHEASBY: I'm sorry about that.

MR. DOWD: Did you give the witness a copy?

MR. SHEASBY: Do you want me to give the witness a copy or do you want to have it?

MR. DOWD: I'll take both.

MR. SHEASBY: I only have one.

MR. DOWD: Then we should give it to the witness.

MR. SHEASBY: May I approach, Your Honor?

THE COURT: You may. The question that's posed is what?

BY MR. SHEASBY:

Q The question that's posed is you gave the opinion that you thought the Haswell was not comparable to the A7 and A8; correct?

A Yes, that's correct.

Q And if we turn to page 62 of that presentation,

you'll see that the title of the slide is Single Thread --

THE COURT: It's also on your screen.

Q *Single Thread Geekbench Results at Two Gigahertz.* Do you see that?

A I see that.

Q And you'll see that on the left is the A7 at 1; correct?

A Yes.

Q And in the middle is Haswell, which is between 1 and 1.5; correct?

A That's correct.

Q And the A8 is actually higher performance on Geekbench than the Haswell; correct?

A So at the top it says at two gigahertz.

Q That's right. When you run the experiment at two gigahertz, the A8 actually outperforms Haswell; correct?

A Yes, with that qualifier.

Q And when you run the experiment at two gigahertz, the A7 actually comes close, within .25 of Haswell; correct?

A Define close. That doesn't look close to me.

Q So you don't believe the difference between 1 and 1.25, you think that's not that close?

A 25 percent.

Q Okay. Now, this is an experiment that was run at two gigahertz; correct?
A That's correct.
Q And the Apple processor doesn't run at two gigahertz in the phone because it would suck up too much power; correct?
A That's correct.
Q But what this slide does show is that when you give Haswell and A8 the same amount of power, A8 outperforms Haswell; correct?
A No, I wouldn't characterize it as the same amount of power. I suspect they have different -- consume different amounts of power.
Q When you run both the A8 and Haswell at two gigahertz, on the Geekbench score the A8 outperforms Haswell; correct?
A Yes. When you bring the Haswell to two gigahertz, I would believe -- I have no reason to dispute these numbers.
Q Sure. And so --
MR. SHEASBY: Your Honor, we would offer this into evidence.
THE COURT: I'll reserve on its admission.
MR. SHEASBY: Thank you, Your Honor.
BY MR. SHEASBY:

Q Let's talk about Samsung next. And by Samsung, I mean the chips that are manufactured in Austin.
A Okay.
Q Now, in Austin the logic circuits for the processor are put on the wafer for each processor; correct?
A There's photolithography transistors and wires, yeah.
Q That creates the logic circuits in the processor?
A I wouldn't characterize them as being the logic circuits because they're not complete. But like I said, it's the wires and transistors.
Q And the wires and transistors for the LSD predictor are put down on each of the little spots on the wafer in Austin, Texas; correct?
A It applies to the whole chip, including the LSD predictor.
Q So the wires and transistors for the whole entire chip are placed in the individual locations on the wafer in Austin, Texas; correct?
A That's correct.
Q Now, the steps that occur in Korea, you talked about wafer bumping; correct?
A That's correct.
Q You talked about cutting out the individual chips from the wafer; correct?

A That's right.
Q And you talked about something relating to blowing fuses and testing the chips; correct?
A Yes.
Q Now, does the word bump occur anywhere in the '752 patent?
A I don't recall the word bumped in the patent.
Q Does the word singulation occur anywhere in the '752 patent?
A I don't think so.
Q Does the word blown fuses and testing chips appear anywhere in the '752 patent?
A No.
Q And you were here for Mr. Colwell's testimony yesterday; is that correct?
A That's correct.
Q Dr. Colwell. You were here for Dr. Colwell's testimony yesterday; correct?
A Yes, I was.
Q And Dr. Colwell was asked the question: "Other than the predictor circuit, does the '752 cover other parts of the processor?" And he answered "No." Correct? Do you remember that?
A That sounds right.
Q And do you agree with him or do you disagree with

him?
A Well, they're interfaces, but I would generally agree, yeah.
Q And the transistors and the wires for the LSD predictor as we discussed are created in Austin, Texas; correct?
A That's correct.
Q Now, when you looked at claim 1, you didn't understand it to be requiring that the processor actually be doing things; correct?
A That's correct.
Q And claim 1 --
MR. SHEASBY: Let's actually pull up claim 1, Mr. Oppenhuis. Checking our time. Claim 1.
Q Claim 1 refers to two types of circuits, a data speculation circuit; correct?
A That's correct.
MR. SHEASBY: Can we highlight that, Mr. Oppenhuis, up top, second line -- third line. Data speculation circuit. Thank you so much.
Q And the data speculation circuit is made up of wires and transistors; correct?
A That's correct.
Q And those wires and transistors are put down in Austin, Texas; correct?

A That's correct.
Q And let's go down -- then there's another circuit that's talked about in the '752 patent. That's the data speculation decision circuit.
MR. SHEASBY: Why don't we go down and highlight that now.
Q And the wires and transistors for the data speculation decision circuit are laid down in Austin, Texas; correct?
A Yes.
Q And you showed Mr. --
MR. SHEASBY: Mr. Dowd, can I have your demonstrative, sir? The A7. Thank you so much.
Q So Mr. Dowd showed you a big glossy 300-millimeter wafer; correct?
A He handed it to me, yes.
Q And that wafer is not actually what is completed in Austin and sent to Korea; correct?
A That's correct.
Q What is completed in Austin and sent to South Korea is the wafer with each of the individual chips on it; correct?
A Yeah, as depicted in my slide.
Q Let's go to 11-37. So each of these things are individual chips; correct?

A They're die.
Q The die. And die is a fancy word for the -- you have dies on a wafer, then you cut out the dies and they become processors.
A That's correct.
Q Okay. Now, the processing of bumping and singulating and testing and blowing fuses, what is the comparative cost of doing that to the process of laying down the billion or in case of -- the billion transistors that exist in the A7 processor that are created in Austin, Texas?
A I don't have the cost data of the breakdown of that.
Q Would you take my representation that the vast majority of the costs of the processor --
MR. DOWD: Objection, Your Honor.
THE COURT: I don't know what the objection is.
MR. DOWD: Foundation.
THE COURT: You want him to assume what? You should be seated. What is it you want the witness to assume?
BY MR. SHEASBY:
Q I want you to assume that the vast majority of the cost of making the wafer is putting down the photolithography.

A Okay. You're asking me to assume that.
Q Okay. Now, you didn't take that fact into account in rendering your opinion; correct?
A I did in that I didn't -- I don't think that it makes a difference.
Q So now let's talk about your work on benchmarks. Now, one of the benchmarks that we've run in this case is Dhrystone, at least one of the benchmarks that's been run by WARF is Dhrystone; correct?
A I also ran that.
Q You ran Dhrystone as well?
A I ran everything that WARF ran, everything that Dr. Reinman ran and more.
Q And you said that Dhrystone is criticized almost universally; correct?
A That's what I said.
Q And you understand that Apple's engineers who designed the LSD predictor have discussed using Dhrystone to assess performance; correct?
A They use it to find divots.
Q Well, let's go to August cross, Slide 11. So this is a slide of a quote from Mr. Mylius, and this document is already in evidence. He says -- he's reporting on the power consumption of the LSD predictor when running on Dhrystone; correct?

A Yes, he's commenting on Dhrystone and the power while running Dhrystone.
Q And he doesn't use the word to test for divots there, does he?
A He doesn't use the word.
Q Now, let's go to Slide 12. And this is a slide also prepared of a document from the Cyclone program update; correct?
A Yes.
Q And in this document they're talking about measuring power using Dhrystone; correct?
A That's correct.
Q And no reference to divots on this page; correct?
A No.
Q And the -- one of the primary benchmarks that Professor Annavaram used to measure power was Dhrystone; correct?
A He used it, yes.
Q Now, you also talked about SPEC 2000 and 2006; correct?
A That's correct.
Q And we talked about the fact that a senior Apple engineer described it as industry standard; correct?
A I believe I've seen that.
Q And you were suggesting that Professor Reinman

should have run more SPEC benchmarks; correct?
A Yes.
Q And you ran as many as you could; correct?
A That's correct.
Q And do you remember when Mr. Williams testified, it was last week, he said at the beginning "All we had was a goal of one SPECint per blank." Do you remember that testimony?
A I remember that.
Q In other words, they are defining the processor at the beginning, at the beginning based on SPECint; right?
A On SPECint.
Q SPECint; right? And you ran SPECint in this case; correct?
A So I ran programs from the SPECint side of SPEC as well as SPEC FP side of SPEC.
Q And he referenced SPECint 2000, I believe; is that correct?
A It was either 2000 or 2006.
Q We'll do both. So let's pull up August cross No. 2. So for your SPECint 2000 numbers, for the 5s and the 6 plus, the performance benefit of using the LSD predictor was over 12 percent; correct?
A That sounds about right. Do you want me to check?
Q No. I checked it myself. And for SPECint 2006,

the performance benefit that you calculated for the iPhone 5s and iPhone 6 was over 9 percent; correct? Why don't we go to the next slide.

A That sounds about right.

Q And those numbers are both higher than the 8.55 percent Geekbench number that Professor Conte suggested should be used conservatively; correct?

A They're both higher than Geekbench, yes.

Q And in fact, if we combine all of SPEC CPU together, every SPEC you ran, every part of the SPEC you ran, all 27 of them, the number is greater than 9 percent performance improvement; correct?

A That sounds about right.

Q Go to the next slide just so we can see that. So you know I'm telling you the truth. When we ran every SPEC together, your numbers were greater than 9 percent; correct?

A That sounds about right.

Q Okay. So you talked about Basemark; correct?

A Basemark X.

THE COURT: Mr. Sheasby, how much more do you have for this witness?

MR. SHEASBY: 15 minutes.

THE COURT: All right. We will take our lunch break at this time and we will reconvene at 1:30. All

rise, please.

(Jury excused from courtroom at 12:31 p.m.)

THE COURT: If the parties would please be seated. The first matter of business is -- and you may step down. Because you are in your cross now, you shouldn't speak to anyone.

THE WITNESS: Okay. Thank you.

(Witness excused.)

THE COURT: PX 161. It sounded as though the defense had a concern, other than you hadn't seen the exhibit, and I guess you still have it since it's up there. But there's a reference within the guide. There were a number of objections to it. I don't know if they stand any longer.

161 was the system-on-chip presentation by Apple, internally by Apple.

MR. DOWD: Your Honor, I still haven't seen it, but I think it's going to be fine.

THE COURT: Well, the objections were mainly to relevancy and to motion in limines that wouldn't prevent it, so I'm going to admit it.

MR. DOWD: Thank you.

THE COURT: The next category is the exhibits that were offered with respect to the declaration of David Papworth. They seem to meet all the requirements

of 902.11 with -- and certainly if the objection is relevance, I'm going to admit them since they were something, as I understand it, had been relied upon by Dr. August and you certainly had an opportunity to challenge him with respect to those. My only concern is the declaration appears to have been provided two days ago and I don't know the nature of the concern, if any, with respect to the representation by Papworth.

MR. HEINRICH: In fact, we just received the declaration today even though it's dated two days ago. And we do have some concerns with those representations.

THE COURT: In fairness, if it's dated two days ago, I'm not sure that the other side would have received it any sooner since it's quite a packet of materials. I assume they got it yesterday. But regardless, your concern is what?

MR. HEINRICH: Well, our concern, for example, with 723.

THE COURT: That's tab C?

MR. HEINRICH: Correct. The declaration of Mr. Papworth doesn't answer the questions regarding the status of that document or whether that document actually is describing the commercialized version of Sandy Bridge. It doesn't answer any of the business records issues regarding that document.

THE COURT: Was this among the -- were each of these exhibits among those relied on by Dr. August or listed by Dr. August in his report as having been something he had seen?

MR. HEINRICH: I believe that's the case.

MR. DOWD: It is, Your Honor.

MR. SHEASBY: It is, Your Honor.

THE COURT: All right. That's fine. The rule requires a fair opportunity to challenge, as I read it, to challenge the proponent, and I don't know how that could have been accomplished here. So I'm not sure on what basis I would admit it into evidence. Your expert relied on them. He explained his reasons. I don't know what else I can do in terms of admission under 902.11. If you wanted them admitted into evidence -- had these been previously marked as exhibits in the case?

MR. DOWD: Your Honor, if I could explain that.

THE COURT: You didn't expect there to be any objection to these at trial. Is that your explanation?

MR. DOWD: I didn't expect there to be an objection on this basis. Mr. Papworth is an employee of Intel, third party. He was out of the country unavailable. To address the objections, we worked very hard to get his declaration, which we received yesterday and provided yesterday by email.

THE COURT: Which would have been great if you had worked just as hard to advise plaintiff WARF that you intended to offer him in that manner so that they had some warning and they could at least address it with you.

MR. DOWD: I believe there wasn't -- I don't think that this is coming as a surprise that we wanted to offer these exhibits because they were marked --

THE COURT: No, no, the surprise is whether or not this declaration was adequate. And if you had been talking about this in advance because of unavailability, they might have been able to address it. In other words, you're trying to get it in under a special Federal Rule of Evidence 901.11 which requires that the party has a fair opportunity to challenge them and I read them to be the proponent give an adverse party reasonable written notice of the intent to offer the record and for the party to have a fair opportunity to challenge them. And it includes the record and the certification available for inspection.

MR. DOWD: And --

THE COURT: This has only come to their attention, I guess, today.

MR. DOWD: Well, Your Honor, we did provide it as soon as we got it, which was yesterday. I think --

THE COURT: You knew he wasn't going to be here. You wanted to offer these exhibits. And you didn't provide the declaration under 902.11 until now. I'm not -- I understand you have lots of things you're doing in this case, but...

MR. DOWD: Your Honor, if I could, I don't understand there to be any challenge to the statements that are made by Mr. Papworth under the pains and penalties of perjury as actually being not his testimony, and that's really what this goes to. Mr. Papworth has provided this as a sworn declaration under 28 U.S.C. Section 1746.

THE COURT: Well, I don't think you're being completely fair. But let's go through it then one at a time. As to attachment A, is there an objection to the use of this or to the admission of this exhibit, 721?

MR. HEINRICH: So there is, Your Honor.

THE COURT: And the objection is what?

MR. HEINRICH: For all of these, that this has not been a surprise to them that we've been challenging these documents since they weren't addressed in Mr. Papworth's deposition. We didn't have an opportunity to examine him on the relationship between these documents and the commercialized products and we've made that --

MR. DOWD: Your Honor, on this very point the documents weren't produced until after Mr. Papworth's deposition and that's why neither one of us had the opportunity to ask him about them. If I look to the objections that were made on this, it's relevance, foundation, hearsay and --

THE COURT: Which goes to the point that was just discussed. Are these, in fact, the specs for the Intel document? I'm not sure how we can make that determination based on the document.

MR. DOWD: Mr. Papworth addresses that in two ways: He says in paragraph 5 that "Document A describes the technical features of Intel's narrowing processors." And in paragraph 4, that it is a true and correct copy of the record that was created on that date.

And then the second is in paragraph 14, he says that this document, "Exhibit A, was kept by Intel in the course of regularly conducted activities at Intel's business and that making these documents" --

THE COURT: I think you meet all of the requirements of 902.11, including 803.6 (a) through (c), which is a requirement, but you still have an opportunity, as I read this, to challenge the affidavit, the declaration.

MR. DOWD: And Your Honor, in terms of meeting

the objections that were made to this exhibit, I think that that means that we have met the objections and that the question is going to the weight that the document should be given, which could be done through cross-examination.

THE COURT: I'm just looking at 902.11 which says "before the trial or hearing, the proponent must give an adverse party reasonable written notice of the intent to offer the record so that the party has a fair opportunity to challenge them." You haven't done this before the trial or the hearing.

MR. DOWD: With respect to the record itself, we did. We provided notice to WARF of our intent to offer DDX 7-21. We didn't have a certification to provide any earlier than we did and that's because it was from a third party who was outside of the country and we could not access --

THE COURT: All right. Why don't both sides provide me any citations in support or in opposition to the admission of a record through declaration during the course of a trial and I'll take it under advisement.

The last issue I just want to briefly address is how we frame the issue for the jury. And the jury hasn't -- the jury has not received instructions as to how to think about the chip on a -- I'm sorry, is it

called a disk?

MR. DOWD: A die on a wafer.

THE COURT: A die -- a wafer on a die. The wafer is the bigger.

MR. DOWD: Right.

THE COURT: All right. So I think in your instructions you were calling it a chip.

MR. DOWD: No.

THE COURT: But in any event -- well, no, actually I think it was yours. But if the question is for a die on a wafer, I take it that the claim of infringement is as to claims 2, 3, and 5? Actually, why don't I hear from WARF as to what claims you believe are infringed.

MR. CHU: It's all the same claims: 1, 2 --

THE COURT: One says in a processor capable of executing program instructions. It's not in a processor capable of executing program instructions; right?

MR. CHU: No. Our position is that it is.

THE COURT: I'm just completely lost as to what -- the parties seem to be focusing on the same thing which is the effect -- the ability of the die or I guess we can't say wafer anymore, so we'll say the die to function in a manner which infringes the claims in the patent. And if the question the jury has to decide is

whether bumping, blowing, fusing, and dicing is required before it is capable of infringing, that would be one way to frame it. But neither side has really done a very good job of proposing language for the jury to think about how it determines infringement; that is, what's -- what is this -- I guess maybe we do mean the wafer. What is it that you're claiming is infringing at the time it leaves Samsung's plant in Texas?

MR. CHU: With the Court's permission, may I just spend 30 seconds on the concepts?

THE COURT: Yes.

MR. CHU: The wafer is the huge disk. It has many chips or die or processors on it. So those three terms --

THE COURT: But is that clear that that is a processor?

MR. CHU: All -- every one of the -- let me call them the little squares that are --

THE COURT: That's fine. You can call them -- let's stick with chip.

MR. CHU: Okay. Every one of those chips, when it leaves the plant in Texas, has one billion or more transistors all connected.

THE COURT: All right. Let's make it simple. Both of you should provide a specific instruction to the

jury, as you propose it, so that they clearly understand the question that's being proposed to them with respect to those chips. It's simply not enough to tell them that you have to find whether they infringed the claims, because we're well beyond that. It's whether or not they are enabled, I guess, would be one way of phrasing it without bumping, blowing or dicing. Some explanation as to what's left for the jury to find before they can find infringement with respect to those manufactured chips. And the sooner you can provide it the better.

MR. CHU: We will do that.

THE COURT: Okay. Was there anything more then for WARF before we take our break?

MR. SHEASBY: Your Honor, there was a sidebar about the cSim versus engineering device issue and we're preparing a written proffer. It may have already been served, so just to explain the difference. Just --

THE COURT: I understand the difference between the two and I understand that you were never given access to the cSim.

MR. SHEASBY: Yes.

THE COURT: And that you ultimately arrived at a compromise. My problem is that you didn't go back to Judge Crocker and say we need to run the same tests on the cSims as Mr. Williams did. Now, you may have

concluded that Apple was going to oppose everything and you wouldn't get it, but I don't read Judge Crocker as ever saying you wouldn't get that. I think it's clear you weren't going to get most of what you asked for, including any kind of testing of alternate product. Apple had planted its flag in the ground, and reading Judge Crocker, I think it's fair to say that he wasn't going to insist on that. But you didn't try to make a showing that you needed to test Mr. Williams' recollection since there wasn't any evidence.

Had you gone back to Judge Crocker on that, readings his rulings, it's not clear to me you couldn't have gotten that. Now, maybe there's something about that testing that Apple represented to you during the course of the instructions. Clearly Apple did everything they could to keep the simulator from being used in this case. But I don't know that I can give you an instruction that goes as far as Mr. Frischling's questions suggested which was that you were denied access to the sims for that specific purpose.

MR. SHEASBY: And we will address that in our filing because our motion to Judge Crocker was to be able to run tests on the actual LSD design in silicon.

THE COURT: It was.

MR. SHEASBY: It was. That was part of it.

THE COURT: And he sent you back --

MR. SHEASBY: Oh, I understand your distinction.

THE COURT: -- to discuss it and to see if you could reach some agreement and you compromised on running the machines. Now, I agree it's not totally fair to say that that was all on WARF. Apple was refusing any use of the sims. But it's not clear to me that you ripened the issue as you should have with respect to Mr. Williams' test.

I don't expect Apple to try to use this as an opportunity because they took a very hard position that the sims shouldn't be used, but I also don't know that I can leave it that WARF was denied the opportunity to run a sims with respect to Williams. That's where I'm considering.

Perhaps I don't give any more instructions to the jury since I cut off the questioning and it's fair to both sides to leave the record ambiguous, but I'm at least giving you the opportunity to address it. I understand you submitted something. I'll look at it.

MR. SHEASBY: Thank you, Your Honor. That's all.

THE COURT: Anything more for Apple?

MR. LEE: Nothing, Your Honor.

THE COURT: Very good. We are in lunch recess. We'll reconvene at 1:30, and you're free to move about as you wish. Actually we'll go on the record for one statement. Mr. Sheasby, you should be tightening up the remaining of your cross.

MR. SHEASBY: I will, Your Honor. Thank you.

THE COURT: Thank you.

(Noon recess 12:48 p.m.)

* * * * *

I, LYNETTE SWENSON, Certified Realtime and Merit Reporter in and for the State of Wisconsin, certify that the foregoing is a true and accurate record of the proceedings held on the 15th day of October 2015 before the Honorable William D. Conley, Chief Judge for the Western District of Wisconsin, in my presence and reduced to writing in accordance with my stenographic notes made at said time and place.
Dated this 10th day of November 2015.

/s/_____

Lynette Swenson, RMR, CRR
Federal Court Reporter